

Report of the On-Site Inspection Workshop-6: OSI Technologies: Methodologies and Techniques for Application

V. Krioutchenkov

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REPORT OF THE ON-SITE INSPECTION WORKSHOP-6:

OSI Technologies: Methodologies and Techniques for Application

Vienna International Center, Vienna, Austria, 26-30 June 2000

Head of Organizing Committee:
Vladimir Krioutchenkov

Chairman:
Vitaliy Shchukin

Rapporteur:
Jerry J. Sweeney

Executive Summary

On-Site Inspection (OSI) Workshop-6 met 26-30 June 2000 in Vienna, hosted by the Provisional Technical Secretariat (PTS) of the CTBT Organization. The purpose of the workshop was to provide guidance on OSI Operational Manual (OM) development for Working Group B (WGB) of the CTBT Preparatory Commission (PrepCom) in the general areas of equipment and logistics. The two main sessions of this workshop, titled "OSI Equipment: Development of Functional and Operational Requirements, Specifications and Application Procedures" and "OSI Logistics: Continued Work on Standing Arrangements, Status of Inspectors and Support Equipment Issues" reflected this focus.

For this workshop, the schedule of work was divided into two parts: The first half of the week were sessions with formal paper presentations and discussion; the latter half of the week used two smaller subgroups to focus on and discuss separately equipment and logistics issues. Drawing heavily on the results of the five previous workshops, these subgroups produced material to be considered by Working Group B. This provisional material is intended to advance the process of equipment definition and procurement and establish procedures for logistics that can be incorporated into the OSI Operational Manual. The participants agreed that using subgroups in this workshop was an especially effective mechanism for discussion of different expert opinion on technical issues, and that having access to material presented at the previous five OSI workshops was particularly valuable.

In the area of OSI equipment, presentations and discussions focused on development of functional requirements, equipment specifications, and application procedures for the initial and continuation periods of inspection in addition to drilling and additional overflights. Two papers presented preliminary functional requirements and equipment specifications that formed the basis of discussion in the later subgroup session. Other papers were presented on procedures and capabilities for on- and off-site analysis of noble gases, for conductivity measurements, results of thermal analyses at former underground nuclear test sites, approaches to the use of active seismic methods, and a suggested set of guidelines for procedures of continuation period activities. In the subgroup, most of the time was focused on developing a table containing functional requirements and equipment specifications for equipment to be used during additional overflights and during the continuation period of an OSI. An additional section of the table was added to deal with the particular issue of position finding during the additional overflight and how it can be interfaced with the measurements being carried out on the aircraft. A short amount of time was spent discussing procedural issues; this subject was only just touched upon. The main result of the subgroup session is an extensive table, attached to this report as Appendix A, that Dr. Shchukin will place into the Expert Communication System (ECS) for comment prior to the next meeting of Working Group B in August. This table is intended to form the basis for, and the development of, the procurement specifications.

Presentations and discussions in the logistics session focused on inspection team composition, privileges and immunities of inspectors, team assembly issues, standing arrangements related to the designation of points of entry (POE) and use of non-scheduled aircraft, logistical requirements for establishing the base of operations, and application of an integrated expert system to OSI activities. The papers provoked lively discussion during the initial session that

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carried over into the subgroup session. The subgroup session focused on discussions of many of the issues brought up in the paper presentations and on preparing possible resource material for development of the OSI Operational Manual. Most participants expressed the belief that subgroup discussions are the preferred format for this effort. The subgroup discussion results, in the form of appendices to this report, range from detailed language recommended for consideration for a specific section of the OSI Operational Manual to annotated outlines or lists of issues needing further elaboration. Participants also proposed that Dr. Shchukin identify some logistical issues highlighted in Appendices B-T and, using the ECS, open them for discussion and resolution at the next WGB meeting in August.

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Introductory Remarks

Ambassador Wolfgang Hoffman, Executive Secretary of the Preparatory Commission, welcomed participants to the workshop. He noted that past workshops have been productive and useful for the development of inspection methodology, technologies and procedures, especially in the areas of nuclear inspection phenomenology, application of inspection procedures, and administrative and logistical matters. He emphasized the importance of the WGB focus on development of the OSI Operational Manual and the need for conceptual evaluation, detailed procedural formulation, and clarification of technical issues—all issues that can be addressed by this workshop. He also stated that the PTS, as the sponsor of workshops, remains open to suggestions for improving their productivity, efficiency and relevance.

OSI Programme Coordinator in WGB of the Preparatory Commission, Dr. Vitaliy Shchukin, introduced the workshop program. He noted that significant parts of the past workshops have been used by the PTS and national experts in preparing input for the OSI Operational Manual and emphasized that the current workshop is designed to be even more focused in that regard. He introduced the program and identified the two subject areas: equipment and logistics. He called attention to session C, which involved subgroup discussions led by Subject Leaders and is intended to provide information designed to speed up the process of OSI equipment procurement and operational manual drafting efforts.

Dr. Vladimir Krioutchenkov, Director of the OSI Division of the PTS, provided a report on the progress and current tasks of the OSI Division. He noted that currently the main part of the work of the OSI Division is supporting the development of the OSI Operational Manual, in the form of direct PTS contributions of text and providing support to the Friends of the Program Coordinator in compiling and editing the Operational Manual contributions. He reported on the current status of planning for a field methodology experiment currently planned to take place in 2002. Also reported upon was progress on the following items: a second PTS Table top Exercise (scheduled for late November 2000), the experimental OSI advanced training course (scheduled for mid November 2000), status of development of the long range training and exercise program, procurement of radionuclide equipment, and testing of the seismic aftershock system purchased by the PTS in accordance with the WGB recommendations.

SESSION A: OSI Equipment

Subject Leaders for these sessions were Dr. Al Smith (United States) for session A1, Dr. Vladimir Nogin, (Russian Federation) for Session A2, and Dr. Li Hua (China) for Session A3.

The purpose of these three sessions was

- ❑ to consolidate material presented in past and current workshops,
- ❑ to define functional requirements and equipment specifications leading to procurement specifications for WGB consideration, and
- ❑ to develop operational procedures for equipment to be used in additional overflights and during the continuation period of an OSI.

Session A1: Development of Functional and Operational Requirements, Specifications, and Application Procedures.

The session introduced functional requirements and equipment specifications for OSI technologies during additional overflights and continuation periods. Dr. A. Smith (United States) was Subject Leader for this session. Presentations and papers of this session were:

1. Sweeney, Jerry J., United States, "Functional Requirements for Continuation Period Equipment and Drilling ." (CTBT/OSI/WS-6/PR/3 and CTBT/OSI/WS-6/PR/3/Add.1)
2. Smith, Albert, United States, "OSI Equipment Specifications and Operational Procedures: A Summary of Workshops." (CTBT/OSI/WS-6/PR/4 and CTBT/OSI/WS-6/PR/4/Add.1)
3. MacLeod, Gordon and Dennis Barker, United States, Technical and Logistical Implications of CTBT/OSI Data Collection." (CTBT/OSI/WS-6/PR/5 and CTBT/OSI/WS-6/PR/5/Add.1/Corr.1)

Discussion Summary

Dr. Sweeney suggested a set of practical functional requirements for additional overflights and the continuation period equipment. The requirements take into account normal environmental or geological background "noise"; this is considered to interfere most with detection of an anomaly and varies from site to site. Synergy or coincidence of complementary data from other technologies can improve the detection threshold. The equipment must be functional for field use; thus, any equipment must be easy to use, rugged, and operate under a wide range of environmental conditions. The technologies are commercially available, have well-established operational procedures, and often depend upon position finding equipment. Dr. Sweeney summarized the functional requirements for additional overflight technologies (multi-spectral imaging, aerial gamma spectroscopy, and aerial magnetic field mapping) and those for the continuation period (resonance seismometry, active seismic methods, magnetic field mapping, gravitational field mapping, ground penetrating radar, and electrical conductivity measurements), and those of drilling.

A question arose on what is actually being detected: Is it the cavity or rather the fractures and chimney rubble associated with it? It was suggested (without reference to case studies) that the technologies, such as active seismic, are strongly influenced by a fracturing surrounding the cavity. In that case, analysis of shear waves may be a more effective approach. Drilling depends upon locating this fracture zone with sufficient accuracy for the desired sampling. Another participant suggested that drilling will have compromises: if slant drilling from the side attempts to hit the fracture zone or cavity, the positional control of the drill is more difficult as the slant increases, and the potential error might increase to 20 to 50 meters.

During the discussion, it was emphasized that additional overflights require the permission of the inspected State Party (ISP) and special arrangements for flying at very low altitudes are needed for magnetic and gamma mapping. Participants noted that the magnetic anomalies might be small and numerous, and many may not be related to an explosion. These anomalies would be broader and lower amplitude if observed during an overflight, but deeper artifacts such as casings would be distinct. Ground penetrating radar (GPR) might be useful for the detection of near-surface fractures induced by the explosion; however, no information was presented to substantiate this.

The Subject Leader, Smith, summarized the requirements presented in previous OSI workshops, incorporated the functional requirements suggested by Sweeney, and extended these to a set of representative equipment specifications and procedures for the additional overflights and continuation period technologies. The results are presented as a table for each technology and give categories for functional requirements, summary of workshops, specifications, procedures, and examples of manufacturers. It was emphasized that these are mature technologies, typically using digital acquisition to expedite acquisition of data, its seamless integration with auxiliary positional information, and its reduction, interpretation and visualization. It was suggested that their application in the field requires only normal geophysical practice together with any provisions necessary for confidentiality. These conditions could be met by existing, commercially available equipment used for geophysical fieldwork. Smith suggested specifications consistent with the objectives and the currently available equipment.

The participants in the working session adopted the equipment specifications table with modifications; they discussed, added and revised the suggested requirements and specifications for each OSI technology, and presented it as a draft for WGB consideration in Appendix A: "Table of Functional Requirements and Specifications for OSI Equipment." This table did not include drilling technology, which participants agreed needed much further discussion before equipment specifications could be developed. However, the functional requirements for drilling provided in the presentation by Dr. Sweeney were discussed and are included here:

The objective is to safely drill into or close to an explosion cavity and retrieve samples for radiological analysis. The equipment should be capable of directional drilling to depths/distances of up to 2 kilometers with an accuracy of 10 meters. Rapid drilling rates are necessary in hard rock, and measurements of high levels of gamma radiation (10,000 to 60,000 counts per second for a standard NaI gross gamma detector [e.g. a 15.24 cm X 5.08 cm crystal] – minimum of 50 times

background) near the drill bit while drilling. An easily transported system capable of drilling from inside a mine or tunnel as well as from the surface is preferred. Subsurface steam pressures may be encountered; thus, the system must include blowout protection to prevent uncontrolled surface release of gases, including radioactive gases, for both safety and environmental protection.

The integrity of the collected data was the subject of the presentation by MacLeod. The inspectors must operate in a methodical (the term “forensic” was used by the speaker) manner to assure that the data withstands scrutiny; otherwise, any conclusions based on this data could be called into question and require resampling according to adopted procedures. One approach to guarantee data pedigree uses photographic documentation (still and video), GPS time and location stamps, and unique identifiers during the sample handling. The chain of custody would be maintained through seals, archived with the data and samples. This data pedigree needs to be reflected in the OSI Operational Manual, and be as universal as possible between the OSI technologies and inspection activities. This requirement impacts, then, future inspector training.

During the discussion it was noted that these procedures do not fit under a standard such as ISO25, since it is a field operation and not one in the laboratory. Each technology is slightly different, but the need for an audit trail was considered essential. Other agencies such as the IAEA might prove a good example too.

Session A2: Initial Period of Inspection

Technologies and phenomena related to the initial period of an OSI were presented in this session. Dr. V. Nogin (Russian Federation) was Subject Leader for this session. Presentations and papers of this session were:

1. Brachet, Guy, France, “On/Off Site Analysis for OSI.” (CTBT/OSI/WS-6/PR/6 and CTBT/OSI/WS-6/PR/6/Add.1)
2. Nizamov, A., V.P. Busygin, P. Khokhlov, M.V. Shchipletsov, Russian Federation, “Heat Radiation Displays in an Epicentral Zone of an Underground Nuclear Explosion.” (CTBT/OSI/WS-6/PR/8)

Discussion Summary

Dr. Brachet presented an overview of rare gas formation and analysis. Xenon isotopes are formed by the fission phenomena and radionuclide decay of iodine isotopes. They will be a primary focus during the first part of an OSI. Argon-37 release, as the product of neutron activation of calcium-40 contained in the soil, is strongly dependent on the calcium and water content of the media. Both xenon and argon will migrate along faults and fractures, driven by the barometric pressure (variations) over several weeks and months. They might be the only radioactive signatures of an UNE for an OSI without drilling.

The four existing systems for separation and low level analysis of xenon are being tested in the “Freiburg experiment” within the umbrella of CTBT/IMS. The French equipment is based on

continuous gas separation using a polymer membrane coupled with charcoal beds. All unwanted gases (oxygen, CO₂, water vapor, and radon) are completely eliminated. Finally, pure xenon isotopes are measured by classical gamma spectrometry with off-the-shelf equipment. Detection of xenon peaks during the Freiburg experiment during the last three months was presented and commented on. With only one station, it will be difficult to locate (by modeling) the source of the emission. The existing equipment is a good basis for developing specific modular equipment for xenon analysis on-site. In an OSI, Ar-37 will have to be analyzed off site in designated laboratory. It should be noted, however, that low-level argon analysis is now routinely performed at only one laboratory in the world; work from this laboratory shows that a global background of Ar-37 exists.

The presentation of Dr. Nizamov covered results of experimental studies of temperature variation in an UNE epicentral zone. Data from airborne thermal infrared surveys, as well as data of direct measurements of ground temperature by temperature sensors, were used in this study. Measurements were performed at the former Semipalatinsk Test Site at the places of UNE conducted in tunnels 2 to 25 years after the explosions. A steady temperature anomaly having a specific ring-shaped structure was recorded at the ground zero sites of the UNE. Ground-based measurements have demonstrated that maximum contrast with background reaches 8°C. Temperature anomalies were also recorded by airborne measurements in Kalmykia at the site of a borehole underground nuclear explosion conducted in 1980. The authors of the presentation believe that it is necessary to perform integrated experimental studies aimed at refinement of anomaly features and demonstration of equipment and measurement/processing capabilities. It is advisable to combine this study with similar studies involving other OSI technologies to define methods to integrate these technologies and their interaction (synergy of technologies). During the discussion, Nizamov suggested that additional studies are needed to elucidate the precise cause of the elevated temperature and its relationship to the explosion.

Session A3: Continuation Period

Technologies and phenomena related to the continuation period of an OSI were presented in this session. Dr. Li Hua (China) was Subject Leader for this session. Presentations and papers of this session were:

1. Han, Jimin, China, "Implementation of Transient Electromagnetism Method in the OSI." (CTBT/OSI/WS-6/PR/9 and CTBT/OSI/WS-6/PR/9/Add.1)
2. Mokhtari, Mohammad, Iran, " Seismic Reflection Methods." (CTBT/OSI/WS-6/PR/17)
3. Hua, Li, China, "OSI Equipment (Continuation Period): Application Method and Procedures." (CTBT/OSI/WS-6/PR/11)
4. Popov, Yuri S., and Yuri V. Dubasov, Russian Federation, "Automatic Portable Radiometer of Isotopes Xe ARIX-02 in Atmospheric Air and Subsoil Gas for On-Site Inspection." (paper only) (CTBT/OSI/WS-6/PR/15)
5. Dubasov, Yuri V., Russian Federation, "Seepage of Radioactive Noble Gases after Underground Nuclear Explosions." (paper only) (CTBT/OSI/WS-6/PR/2)

Discussion Summary

The paper by Dr. Han treated the main functions of transient electromagnetic (TEM) measurements in an OSI: composition and specifications of the equipment, working design, and criteria for selection of parameter settings for working devices. Detection of anomalies at shallow depth in a large area requires the use of a device with a smaller power source and small square transmitting loop of about 10 meters on a side. For detection of deep anomalies in a relatively small area a large-size transmitting loop should be used. The most appropriate size of a side of the overlapping transmitting loop should be 0.7 times the expected depth of the anomaly with the size of the center loop being 1.1 times the expected depth of the anomaly. The paper also discussed the measurement grid, selection of the parameter collection, the set-up of the time window, as well as different types of the electromagnetic interference and measures to constrain them, respectively.

During the discussion following the presentation, questions about the nature of anomalies, including detection depth and accuracy, as well as the efficiency of the fieldwork were raised. Dr. Han views that the detection depth of TEM is from about 30 m to 2 km. During the initial search period over several square kilometers, 2-3 experts and 4-8 working days are necessary. While during the later precise locating period, 4 staff and 6-10 days are needed. As for the effectiveness of the method, Han believes that TEM is capable of detecting the buried depth and location of the nuclear explosion cavity.

Dr. Mokhtari emphasized the critical elements for the use of active seismic methods: a sufficiently strong energy source, an observable acoustic impedance contrast associated with the structure of interest, and signal frequencies sufficiently high to separate reflections. Any deployment must first test the acceptability of the energy source and the ability of the geophones to detect deeper structures. But Mokhtari asserts that it is the fractures around the cavity that can be detected; the cavity itself is too small for easy detection. It still must be determined what equipment configuration works in specific geological environments. To this end, experiments are being conducted to evaluate the energy sources, the use of shear wave data, and improvements in field processing. In the discussion, it was emphasized that we know that full 3-D seismic with thousands of geophones can detect the cavity/rubble zone. But the question is, because the limited time available for an OSI requires ease of deployment and faster operations, whether an active seismic survey can be done with a smaller, portable seismic reflection acquisition system with efficient equipment, processing, and interpretation capabilities. Dr. Mokhtari considers that this is possible and their experiments hope to demonstrate it. The source energy is a key problem; whether it is better to use a portable source, good to at least 100 Hz, or a large Vibroseis truck. Its success is, however, very dependent upon the site geology, and each survey must be specifically designed for the location.

Dr. Li Hua gave a comprehensive review of the OSI equipment for the continuation period and suggested how to apply it over several areas, each a few square kilometers in size. Interpreting technologies together allows the coincidence of anomalies to improve the effectiveness of the methods; this synergy of the technologies improves the signal-to-noise ratio. It is suggested that during the selection of geophysical methods to be applied, the working plan should take into

account local geology and environmental conditions (e.g., noise) and the way the techniques will work together in the area. Suggested requirements for OSI technologies are noted in the workshop summaries within Appendix A.

Dr. Dubasov's paper characterized the experience of gas seepage from underground nuclear explosions in Russia according to three categories:

- Complete containment (52.6%)

- Incomplete containment with insignificant seepage of short-lived noble gas radionuclides (42.6%)

- Incomplete containment with forced dynamic release of explosion products in the gas and vapor phase (3.5%)

These releases show a wide variety in the intensity, duration, and seepage channel characteristics.

The paper by Dr. Popov and Dr. Dubasov described an automated system for sampling and analysis of gases for xenon isotopes. Prototype equipment has been developed and tested that can be housed in a minivan and process up to 4 samples per day at levels down to background (10^{-3} Bq/m³) for ¹³³Xe. The equipment is an integrated system incorporating sampling, processing, detection, and analysis components.

Recommendations from Session A:

The participants reviewed previous Workshop presentations and those from this workshop in the later subgroup working session (Session C), and developed draft equipment specifications, together with functional requirements. Options were outlined to reflect different performance capabilities. The main product of the subgroup working session, a preliminary draft of functional requirements and equipment specifications, is contained in Appendix A: "Table of Functional Requirements and Specifications for OSI Equipment." Each technology is contained in a separate table.

SESSION B: OSI Logistics: Continued Work on Standing Arrangements, Status of Inspectors and Support Equipment Issues

The purpose of this session was to continue work, started in earlier workshops, on standing arrangements (to include logistical/administrative standing arrangements), the status of inspectors, and issues related to support equipment. The primary focus was to produce materials that would directly support the development of these elements of the OSI Operational Manual. As in previous workshops, the participants are providing recommendations to Working Group B (WGB) experts for their consideration and approval. Discussions noted three possible avenues to formalize these recommendations as resource documents. These recommendations could be re-issued as (1) national contributions, (2) Task Leader contributions, or (3) PTS contributions for possible incorporation into the OSI Operational Manual. The sequence of presentations and papers provided during this session was:

1. Chi, H., United States, "Inspection Team Composition" (CTBT/OSI/WS-6/PR/7 and CTBT/OSI/WS-6/PR/7/Add.1).
2. Salcedo, L., United States (paper only), "Standing Arrangements: Inspection Team Privileges and Immunities" (CTBT/OSI/WS-6/PR/12/Corr.1).
3. Salcedo, L. and McKay, D., United States, "Preparations for the Conduct of On-Site Inspections: Assembly of an Inspection Team," (CTBT/OSI/WS-6/PR/14 and CTBT/OSI/WS-6/PR/14/Add.1).
4. Salcedo, L. and McKay, D., United States, "Standing Arrangements: Points of Entry and Use of Non-Scheduled Aircraft" (CTBT/OSI/WS-6/PR/13 and CTBT/OSI/WS-6/PR/13/Add.1).
5. Han, D.M., China, "Logistical Requirements for Establishment of the Base of Operations" (CTBT/OSI/WS-6/PR/10 and CTBT/OSI/WS-6/PR/10/Add.1).
6. Nizamov, A., Russian Federation, "Realization of an Integrated Expert System for Inspecting On Site" (CTBT/OSI/WS-6/PR/16).

In addition, a special presentation, at the invitation of the PTS/OSI Division, was given during this session of the workshop by Mr. E. Fusselberger and Mr. G. Trichtl, of Synergis Information Systems, titled "Introducing the New Standard for GIS, ArcInfo8." The presentation was a computer-based demonstration (no written materials provided) of a new standard for a field information management system (FIMS), in this case, a specific geographical information system (GIS) called ArcInfo8. The demonstration reflected the different overlays containing various geological and geographical information, including coordinates, that may be needed by the inspection team to record and analyze results during an OSI. The demonstration was well received and many questions were asked concerning its possible application to specific CTBT OSI requirements. This is a topic that should be addressed by WGB in the near future, since functional requirements and technical specifications will be required if WGB decides to procure such a tool for evaluation and testing.

Discussion Summary

Subject Leader Schroeder initiated Session B with a brief introduction of the objectives of the logistics session and introduced the different presentations. She further proposed different methods (proposed language, outlines, formats and lists) of how the presentations could be incorporated as possible resource materials for the development of the OSI Operational Manual. The subsequent Session C, Subgroup Discussions, proved a very beneficial format for in-depth discussions of all topics, and most participants believed that this is the preferred format for proposing specific resource materials for the Manual. This was specifically beneficial for the logistics portion of the workshop, which produced some recommended resource materials, which will be discussed later in more detail with specific recommendations proposed in the appendices.

To assist in the discussions and preparation of the recommended language in the appendices, excerpts from the current drafting guidelines of the OSI Program Coordinator (CTBT/WGB/TL-4/20 and TL-4/21) were provided to the participants. Workshop participants attempted to produce proposed OSI Operational Manual language in as many of the workshop topics as possible. The overall results of this workshop (Appendices B-T) are reflected in various stages of detail and completeness, which range from detailed language recommended for consideration for a specific section of the Manual to annotated outlines or lists of issues that require further elaboration. Several questions arose during the presentations and discussions related to general drafting issues of the Operational Manual; for example, the balance between the level of detail and the need to maintain inspection team flexibility in the field. Other questions included whether to quote or reference Treaty language and whether something that is not specifically mentioned in the Treaty/Protocol is permitted or prohibited. All these questions are referred to WGB for resolution.

The sequence of the presentations, as provided in the Log of Presentations for OSI Workshop-6: OSI Technologies: Methodologies and Techniques for Application (PTS/OSI/WS-6/3, 30 June 2000) was adjusted to reflect the logical sequence of activities. Following this approach, Chi initiated the presentations and extensive in-depth discussions with the topic of inspection team composition. Workshop participants agreed that a primary factor that the Director-General (DG) must possess is flexibility in determining the composition of the inspection team, as the selection is scenario-dependent. For example, the DG must consider, *inter alia*, the contents of the inspection request, the terrain and climate of the inspecting State Party (ISP), the anticipated ISP infrastructure support, the expertise required, the ratio of inspectors to inspection assistants, the maximum duration of the inspection, and the desirability for phasing and rotation (or substitution) of inspection team members. Several views were expressed on the number and types of inspection team members needed, based on the tasks to be accomplished. This discussion reinforced the need for the TS to have some type of management tool (illustrative templates) that would assist the DG in accelerating the selection of inspection team members in the short time mandated by the Treaty/Protocol.

Participants further agreed that, for efficiency and practicality, the inspection team should have a common working language and that translation and interpretation in the field would be limited

to the inspection team's working language and the ISP language. It was further noted that any reports intended for the use by Executive Council (EC) are to be translated into all the UN languages. Participants also introduced the concept of a "break" in physical presence of the inspection team leader in the ISP if the inspection continues past the initial period of inspection. Such a "break" would confirm the concept of a single inspection team leader for a specific inspection and yet permit the individual to obtain a rest period, as needed. Using these topics and the presentation as the basis, participants developed the proposed language for Section 5.9 of the OSI Operational Manual (Appendix B) for consideration. Also reflected in Appendix B is the list of issues/questions related to inspection team composition that requires further discussion by WGB members.

The next topic (paper only) introduced was the Protocol-specified standing arrangement (having legal obligation) concerning privileges and immunities of the inspection team. During discussions, workshop participants agreed that Treaty language in most cases would be sufficient instead of quoting the Treaty throughout the Manual. Additional language is envisioned only if a specific procedure needs to be recorded or if a term requires a definition; for example, what is the meaning of "codes" in paragraph 27(b) in Section B of Part II of the Protocol; such definitions would be included in the glossary. Participants produced the proposed language for Section 4.4 of Chapter 4 and for the glossary of the OSI Operational Manual (Appendix C) for consideration. The issues/questions raised during the workshop on this topic are also included in Appendix C for WGB consideration.

Salcedo provided a presentation on the preparations required for the assembly of the inspection team. Concepts raised included: a "core" team as proposed in CTBT/PTS/INF.270 and the phasing of inspection team members according to the expertise required and the inspection period. Discussion also focused on the three different options, and the corresponding advantages and disadvantages, of assembling the inspection team. A detailed presentation of these advantages and disadvantages is provided in Appendix D. These options included assembly points at Vienna near the TS, at the POE, and at a regional location. It was noted that, depending on what option is used, the logistical preparations would be affected. Furthermore, the criteria of timeliness, cost-effectiveness, and efficiency are crucial factors in assembling the inspection team. It was determined that, to provide the TS the maximum flexibility in assembling the inspection team, the best approach may be a combination of the different options depending on the scenario and should be so stated in the OSI Operational Manual. It was also noted that it may be necessary to have a regional assembly point outside the territory of the ISP for political and logistical reasons. This regional assembly point would be used not only for preparations for the OSI but also during the conduct of the OSI to facilitate the logistics flow for equipment and inspection team members and for emergencies. This and other issues are indicated in the proposed language for Section 5.10 of Chapter 5 of the OSI Operational Manual (Appendix E).

Salcedo immediately followed with a brief presentation on the Protocol-specified standing arrangements related to designation of the points of entry (POEs) and use of non-scheduled aircraft. The importance of the designation and selection of the POEs and the use of non-scheduled aircraft and the impact on logistics was highlighted. A review of the United States Defense Threat Reduction Agency's experience with other arms control treaties was presented,

specifically providing a case study of CWC-related experiences. Using the presentation materials as a basis, participants proposed language for Sections 4.3 and 4.5 of Chapter 4 of the OSI Operational Manual (Appendices F and G). Discussions also resulted in a proposed notification formats for use by a State Party in designating or changing POEs (Appendix H-J). Additionally, the participants discussed the proposed formats (Appendices K-P) for use by a State Party for the notification of aircraft routings (Treaty terminology) and standing diplomatic clearance numbers for non-scheduled aircraft.

The next presentation, following the logical sequence of activities, focused on the logistical requirements for the establishment of the base of operations. Noting the importance of the selection of the base of operations and its associated support equipment, Han provided the following information: some basic guidance in selecting the location of the base of operations, the basic steps in the establishment of the base of operations, the required infrastructure and logistical arrangements for both the working and living areas, and the need for radiation monitoring and contamination control at the base of operations.

One key issue raised during these discussions focused on the procedures and equipment to be used for radiation monitoring at the base of operations for safety purposes, depending on whether the base of operations is located within or outside of the boundaries of the inspection area (that is, by the inspection team or by the ISP and with whose equipment). Another discussion topic concerns the number of times the base of operations can be established, that is, moved after its initial establishment. Participants questioned whether safety is the only criteria for moving the base of operations, or whether increased efficiency of the inspection team was also a factor. Both issues are included in the list (Appendix Q) that requires further consideration by WGB. A very productive discussion occurred on the proposed annotated outline for Section 6.3.2 of Chapter 6 of the OSI Operational Manual, which is provided as the possible basis for future contributions (Appendix Q).

Nizamov concluded the formal presentation portion of the logistical session of the workshop with a video demonstration on the development of an “integrated expert system” and the desirability of its application to CTBT OSI activities. This system could be applied in both training and operational environments. In the training application, the system could be used to simulate inspection procedures that would increase the readiness of inspection team members. During operational applications in the field, this system could be used to evaluate measurements and provide results that could help the inspection team leader determine future strategies, such as determining the next location for inspection activities and the optimal number of members for such inspection activities. Whether or not this system would be a part of the FIMS (as mentioned above concerning the ArcInfo8 presentation) or a separate tool needs further discussion.

In addition to the scheduled presentations listed above, an informal status report was presented by Dr. Lederman of the PTS/OSI Division concerning the information on topics related to the status of inspectors he had compiled since his presentation (CTBT/PTS/INF.237) at the January 2000 WGB meeting. Dr. Lederman had recently visited the Organization for the Prohibition of Chemical Weapons (OPCW) and learned of the procedures being implemented by

that organization and had started to query other international agencies. In order to meet the WGB tasking to have draft procedures by the end of 2000, Dr. Lederman will continue to contact other international organizations that have similar on-site activities in order to determine if their procedures would be applicable to the CTBT OSI requirements. Unfortunately, due to the lack of time, the participants were unable to focus in more detail on providing additional issues for Dr. Lederman to consider in his work on this topic.

Recommendations

Workshop participants proposed the following recommendations for WGB to consider, decide upon and make formal recommendations to the Preparatory Commission, as appropriate. The following list is ordered in priority with regard to the immediacy of action.

- Request that the OSI Programme Coordinator select some issues from those identified in Appendices B-T for discussion and resolution at the next WGB meeting as well as additional topics for follow-on WGB meetings in 2001. Some suggested topics (in random order) for the next WGB are:
 - The concept of having a TS staff member (not inspection team member) as a liaison at the point of entry of the ISP, as a practical balance to the concept of an ISP liaison at the TS.
 - The number of times that a base of operations may be established (or moved).
 - The distinction, if any, of radiation monitoring procedures and equipment if the base of operations is located within or outside of the boundaries of the inspection area.
 - The formal standing of the different inspection reports and the need for translation into all the UN languages.
 - The definition of inspection activity (what it includes and what it does not include) and its relationship to ISP presence, i.e., transparency.
 - The parameters of the OSI Operational Manual, that is, the level of detail required and whether something that is not specifically mentioned in the Treaty/Protocol is permitted or prohibited. This includes the concept of having the ISP and inspection team leader agree, for practical purposes, on items where the Treaty/Protocol and OSI Operational Manual are silent.
 - A legal interpretation of whether paragraph 36 of Section B of Part II of the Protocol requires the inclusion of the list of inspection equipment in the OSI Operational Manual. Or is it a separate document that is approved by the First Conference of States Parties? Similarly, do the technical specifications of this equipment need to be included in the OSI Operational Manual, or only the “specifications for the use of the equipment”? (This last statement raises different approaches.)
 - The discrepancy of the number of observers listed in the inspection mandate (one) and those specified in paragraph 61 of Section D of Article IV of the Treaty (up to three).
 - The concept of a “break” in physical presence of the inspection team leader in the territory of the ISP, since the Treaty/Protocol specifies only one inspection team leader for a specific inspection.

- Does the inspection process cease if any of the inspection timelines are not met?
 - Discussion and possible acceptance of the recommended terms that are listed in Appendix R for inclusion in the OSI Operational Manual.
 - The extent of ISP presence during all inspection team communications, to include personal communications.
 - The desirability of a regional assembly point.
 - The impact of missed Treaty timelines on the inspection process.
 - The use of more than one POE, i.e., one for inspection team members and one for equipment.
 - The deployment options, to include the concept of phasing and rotation (substitution) of IT members to the POE for efficiency and expediency. Separate arrival times at the POE may impact the “clock” for Treaty timelines.
 - Concept of TS contracting with the ISP or another State Party to provide administrative and logistical support in order to limit the number of such individuals on the IT.
 - The parameters for modification of the inspection mandate (i.e., IT members), if technically no decision is required to permit the OSI to enter the continuation period. Is a legal view needed?
 - The working language of the IT needs to be determined. Is it one or more? And if training is needed, who pays?
- Request that WGB consider the recommended language in Appendices B-T and forward it for further refinement by States Signatories, the OSI Programme Coordinator or the PTS, in order to be reissued as contributions to the Initial Draft Rolling Text of the OSI Operational Manual.
- Request that the PTS develop an indicative project management/decision support tool to assist in determining the composition of the inspection team, based on the specific scenario. Such a tool should include illustrative templates reflecting possible scenarios that would accelerate the selection after an inspection request is received. At a minimum, such templates should reflect the “best case” and “worst case” with respect to the level of ISP support that is provided.
- Recommend that the PTS continue to expand the list (using the list developed in Workshop-5 as the basis) of topics for possible logistical/administrative standing arrangements with States Parties.

Session C: Subgroup Discussions Headed by Respective Subject Leaders.

On the morning of the third day of the workshop, participants divided (by individual choice) into two subgroups for separate discussions of OSI equipment-related issues and OSI logistics. Albert Smith (United States) chaired the subgroup for equipment-related issues and Judy Schroeder (United States) chaired the logistics subgroup.

OSI Equipment Subgroup

The focus of the OSI equipment subgroup was development of a table (Appendix A) containing functional requirements and specifications for equipment to be used in drilling, additional overflights, and the continuation period of an OSI. After an initial discussion about how to proceed, the subgroup agreed to use the paper presented by Dr. Smith at this workshop, CTBT/OSI/WS-6/PR/4, as a basis for discussion. For each type of equipment, a table was to include the following sections: a summary of past workshop recommendations, characteristics of the target anomaly, functional requirements, equipment specifications, general procedural issues, examples of manufacturers of the equipment, comments reflecting discussions that occurred during the workshop, and an additional section for added comments during the review period of the final report. The subgroup further agreed to include a separate table for position-finding equipment needed for additional overflights.

The section of the table titled “Summary of Workshops” is significant because it represents the important contributions of previous workshops to the work of this one. The subgroup drew heavily on the material presented by many previous experts, and Appendix A is an attempt to represent a consensus of opinion of that work of those present at this workshop.

Dr. Shchukin plans to place Appendix A on the CTBTO Expert Communication System for comment by State Signatories prior to Session 13 of WGB of the Preparatory Commission. The intention is to use this table as the basis for developing procurement guidelines for the OSI equipment remaining to be acquired for testing and training purposes. The subgroup also considered the basic application procedures, common for all OSI techniques, presented in the form of a discussion paper in Appendix A1.

OSI Logistics Subgroup

Subgroup discussions began with the overall topic of standing arrangements. Subject Leader Schroeder noted that discussions during both previous workshops and WGB meetings reflected confusion about the definition of “standing arrangement.” It was agreed that in order to develop the OSI Operational Manual, a common understanding should be reached to distinguish between Treaty/Protocol-specified topics (having legal obligations) and the associated logistical/administrative arrangements that support those legal obligations. It was noted that there could be two categories of logistical/administrative standing, or support, arrangements. One category could be “provisional arrangements” (accomplished soon after EIF) and the other category could be “implementation arrangements” (accomplished after receipt of the OSI request). A proposed definition for the glossary in the OSI Operational Manual is provided in

Appendix R. Similarly, participants agreed it would be useful to have a definition of “point of entry” to clarify what is included in the use of this term, and a suggested definition is also provided in Appendix R, along with a list of other possible definitions raised during the discussions.

In addition, the participants discussed an indicative flow chart for the preparation of logistical/administrative standing arrangements by the TS and/or States Parties. The participants agreed that it may be useful to include it as an appendix to this report (Appendix S) as a possible planning or management tool that could be used by the TS. Two illustrative templates for possible logistical/administrative standing arrangements with States Parties are provided in Appendix T.

The concept of an “OSI Handbook for States Parties” was introduced as a mechanism to assist States Parties in fulfilling their obligations under the provisions of the Treaty. This is an issue that requires further discussion either in WGB on the general principle of handbooks or, in future workshops, to develop the overall concept from a technical aspect. The results of the other discussions have been highlighted above, in the discussion of Session B, and are reflected in the appropriate appendices.

Closing Session

The closing session started with summaries, by Dr. Smith and Ms. Schroeder, of the work carried out in the Session C subgroup discussions. The Subject Leaders and participants all agree that the subgroup discussion sessions were a very useful format for advancing the efforts of Working Group B.

Dr. Shchukin then focused the discussion on how the results of the workshop can best be delivered to Working Group B. The consensus was that Working Group B should review the materials in the Appendices of this report and consider them for recommendation to the Preparatory Commission. There are three ways to consider this material for more formal status than that represented by this workshop report:

1. The PTS can incorporate the material into their efforts of drafting material for the OSI Operational Manual.
2. States Signatories can use the material as a resource for their own drafting efforts.
3. The OSI Programme Coordinator can bring the material forward for consideration by Working Group B.

Following item number 3 above, Dr. Shchukin then announced his decision to put the table of equipment functional requirements and specifications (Appendix A), as well as some logistics issues, up for open discussion via the Expert Communication System (ECS) on the CTBTO web site.

The final work of the session was a discussion of the method of work for the next and future workshops. Several topics were proposed by Dr. Krioutchenkov, the Subject Leaders, and several other participants. It was noted that the next workshop would not be scheduled until well into calendar year 2001, after a great deal of work will have been completed on the OSI Operational Manual. Thus, the timing of the next workshop would be especially good for carrying out a technical review of the work accomplished up to mid-year 2001, with an attempt to identify and resolve outstanding issues involving the Manual at that time. The list of topics given in Appendix U reflects those thoughts and priorities.

Acknowledgment from the Rapporteur

Because of the subgroup sessions used in this workshop, the Rapporteur was particularly dependent upon the subgroup chairpersons (Al Smith and Judy Schroeder) to provide material for this report. I thank them for producing such a great amount of material over a very short time. The other Subject Leaders—Dr. Nogin and Dr. Li —also made my job easier by providing input for the sessions which they chaired. The PTS staff provided typing, editing, logistical support, and valuable comments that greatly facilitated the work of the subgroups and the work of putting the report together. I would also like to thank the Workshop participants and speakers for providing the raw material for the report and providing constructive reviews of draft versions.

APPENDIX A

Table of Functional Requirements and Specifications for OSI Equipment

Additional Overflights: Multi-Spectral Imaging [Protocol, Part II, paragraph 80]

Additional Overflights: Multi-Spectral Imaging [Protocol, Part II, paragraph 80]

<p>Characteristics of Target Anomaly:</p> <p>Targets for detection are spatial emissivity [reflectance] changes over small distances due to:</p> <ul style="list-style-type: none"> • shallow-buried artifacts or • surface changes due to <ol style="list-style-type: none"> 1. spall [wavelength range for observation 0.7 to 15 μm], 2. recent equipment operation or facility construction, traffic on unimproved roads, buried features [0.7 to 15 μm], or 3. in surface materials due to spall [0.7 to 15 μm], 4. plant stress due to spall [narrow band at 0.42 and 0.69 μm], or 5. other surface effects such as fractures from an underground explosion [0.4 to 15 μm]. 	<p>Functional Requirements:</p> <p>Common requirements for all options:</p> <p>Detecting spatial variation in an image response at various wavelengths over a wide spectral band, including infrared, of images of the earth's surface from a slow-moving aircraft. The minimum, instantaneous field-of-view of the multi-spectral imager should be no greater than 1 m at a 500m elevation (a 2 mrad aperture). This gives an image resolution of 60-100 cm when the instrument is at an altitude of 500 m. Spectral band extends into near IR, 0.9 μm.</p> <p>Additional for Option 1 and 2, digital CCD acquisition and processing: CCD (charge couple device) digital acquisition or equivalent with at least 8 bits of dynamic range. Minimum of 5 bands (channels), maximum of 15 and include standard blue, green, red, near IR and far IR. Recording images in data retrieval rates equal to or exceeding video. Bandwidth (bw) of channel should be less than 15% of the band wavelength (0.01 μm bw desirable). For plant stress, the equipment should record the 0.69 μm and 0.42 μm wavelengths with bands no wider than 0.03-0.05 μm. For green plant reflectance, also include 0.54 μm (0.03 μm bw) as a discrete measurement. Include discrete wavelengths of 0.75 and 0.85 μm (0.05 μm bw) to allow nearly full characterization of chlorophyll, protochlorophyll, and x-carotene. The infrared images cannot be acquired through window glass at wavelengths longer than 1 μm. CCD sensitive to approximately 2 μm, but precise bands determined by filters. If necessary, far infrared and/or thermal imagery could be accomplished with a separate camera.</p>	<p>Comments</p> <p>IR differentiates natural and cultural features, especially useful for disturbed soil.</p> <p>Definition of Bands: blue (.4-.5 μm), green (.5-.6 μm), red (.6-.7 μm), near infrared (.7-1.0 μm), short wave infrared (1.0-3.0 μm), and thermal infrared (3.0-15.0 μm) bands. [<i>what are accepted wavelengths for bands and terminology</i>]</p> <p>Bands for plant stress use results of Carter, "Ratio of Reflectance in Plant Stress," International Journal of Remote Sensing 15 (3) 697-703, 1994.</p> <p>Some experts believe that plant stress analysis is possible using film medium.</p> <p>(comment added after the workshop: the spectral range in characteristics, items 1-3 is too wide and needs further clarification)</p>
<p>Summary of Workshops:</p> <p>Multi-spectral imaging refers to tens of channels (not a spectrometer), and useful for identifying anomalies or artifacts (variations from the norm). Two levels of sophistication: mounted through a hole in the</p>		

Additional Overflights: Multi-Spectral Imaging [Protocol, Part II, paragraph 80]	
<p>aircraft (superior imagery and spectral separation), or portable for use out of a window (few color filters for spectral discrimination). Skilled operator required, and digital acquisition and processing is the norm. [CTBT/OSI/WS-5/PR/12]</p> <p>A ring-shaped anomaly is detected in the thermal band (3 to 15 μm) from the air on the surface above UNE from 2 to 24 years following the explosion. The anomaly appears to decrease in time, but visible during the diurnal and seasonal cycles. Its origin is unclear. [CTBTO/OSI/WS-6/PR8].</p>	
<p>Specifications:</p> <p>Option 1: Full spectral digital acquisition including IR to 4.5 μm</p> <p>Hardware:</p> <ol style="list-style-type: none"> 1. CCD (charged coupled device) detector with minimum blue, green, red, and near IR, and SW IR (0.6 to 2.2 μm). Longer or shorter wavelengths require a different detector. [MW-IR, 2.4 to 4.5 μm, using separate cooled In-Sb array] 2. 2048x2048 CCD or greater, 8 bit or greater dynamic range. 3. Self-contained system includes differential GPS and a system to record precise image centers. The guidance software provides pre- planned flight lines, with centers and overlaps, as well as in-flight planning 4. a laptop for guidance and system management. 5. pilot display indicator assists the pilot in maintaining flight course and image acquisition control. In-flight control for the following scene spacing, line spacing, and flight-line grid. 6. The camera shutter speed can be set in-flight, and is guided by the scene emittance level to achieve maximum levels of dynamic range. 7. ability to calibrate within $\pm 5\%$ 8. spatial resolution, 2 mrad. <p>Software:</p> <ol style="list-style-type: none"> A. To remove detector and optics anomalies; the resulting flat imagery has improved scene-to-scene consistency. B. Auto-mosaics and geo-references raw data using positional information contained within the image 	<p>Options use Workshops as guidance.</p> <p>Assumes portable aircraft- mounted unit, weight less than approximately 40 kg.</p> <p>Superior imagery and spectral separation.</p> <p>Wavelengths longer than 1 μm (or shorter than 0.4 μm) are not transmitted through most aircraft windows.</p> <p>IR to 4.5 μm considered by some experts as necessary for superior detection of ground disturbed by an UNE.</p> <p>The usefulness of the thermal band is questioned by some experts.</p> <p>Digital acquisition and spatial registration allows automatic computation of plant stress index or other indexes based on ratios of spectral bands. The display of these indexes is a powerful tool to detect</p>

Additional Overflights: Multi-Spectral Imaging [Protocol, Part II, paragraph 80]

header files. Parameters are entered by the user once at startup and then become a hands-free automated process.

- C. Views the mosaic. Mosaic can be zoomed in and observed individually. Areas and distances can be measured. Indexes for vegetation and disturbance of soil can be observed automatically.
- D. Integration with field information management system (FIMS).

and visualize ground disturbance associated with an UNE. (comment added after the workshop: automatic processing will require the use of approved software)

Equipment readily available allows rapid acquisition and efficient visualization.

Additional Overflights: Multi-Spectral Imaging [Protocol, Part II, paragraph 80]	
<p>Option 2: Portable system for window use.</p> <p>Hardware:</p> <ol style="list-style-type: none"> 1. 3-CCD camera area array camera, approximate 1028x 1200 pixel resolution, multi-spectral capable into a least near IR (1 μm), configurable up to 5 bands between 0.4 and 1.1 μm, but 3 visible bands limited to spectral response of a 3-color CCD if 2 other bands are both IR. Ability to change bandpass filters and common aperture preferred for flexible reconfiguration and consistent frame registration. Progressive scan output plus NTSC/PAL for pilot/operator. Minimum 8-bit digital output. Capable of CCD for UV imaging or IR imaging to 2 μm if necessary and integrate on-the-fly into false color digital display. Operate to 7 frames per second (fps). 2. Lens with optical design compatible with camera and spectral bandwidth including IR transmission and optical quality. Has 0.3m resolution of camera system at 500m altitude. 3. Compatible frame grabber. 4. Compatible cable between frame grabber and camera. 5. Processing includes color space manipulation, color plane subtraction and ratios, thresholding and area-of-interest. 6. Compatible (possibly a laptop) PC computer for acquisition and preliminary display, and camera control. Operating system compatible with selected software. 7. Navigation, time and orientation channels desirable and recorded by acquisition computer. <p>Software:</p> <ul style="list-style-type: none"> □ Field information management system (FIMS) for image/spectral manipulation, storage and display. 	<p>A portable system designed for use out of a window, but it lacks additional spectral bands to distinguish disturbed ground at wavelengths greater than 1 μm. Separate equipment is needed for camera orientation and relative position along flight path.</p> <p>No MW IR and poor quality imaging through window.</p> <p>Quantitative indexes based on ratios use available spectral bands.</p> <p>Discrete spectral bandpasses limited to 3, since only 3 separate CCDs are possible with split-prism.</p> <p>(comment added after the workshop: above is for daytime use only, for full range of information)</p>
<p>Option 3: Film recording of visual and Near IR to 1 μm, black and white, or color film</p> <p>False color film based on spectral response of film, or panchromatic black and white film using successive exposures through desired filters. Desired properties of film camera include:</p> <ul style="list-style-type: none"> • IR Black and white film or false color IR film extending to 0.9 μm. • Hand-held camera (35 mm), 15 to 20 cm resolution from 500 m altitude, or • Aircraft mounted camera, 10 to 15 cm resolution at 500 m altitude. • Wratten filter for IR 	<p>Stereoscopic pairs possible.</p> <p>Temperature controlled storage for film (dry ice), can view thru windows since only near IR. Limited to poor haze penetraton.</p> <p>Photography during daytime only, data analysis requires one trained person, and needs separate</p>

Additional Overflights: Multi-Spectral Imaging [Protocol, Part II, paragraph 80]	
<ul style="list-style-type: none"> Necessary processing equipment 	<p>equipment for orientation and position.</p> <p>Does not produce quantitative measure in narrow bands for automated estimate of plant stress indexes or other indices.</p>
<p>Procedures:</p> <p>Imagery will be compared to ground-based and aerial visual photography and human observational experience to eliminate associate obvious effects due to known cultural features or geology. Infrared particularly useful for distinguishing unimproved roads and disturbances, and buried features.</p> <p>For film application, photographs will be compared to panchromatic air photographs and to visual observations to eliminate natural phenomena and cultural features.</p>	
<p>Examples of Manufacturers:</p> <p>Option 1: Spectral Imaging Ltd, DLR e.V., Airborne Data Systems, Kestrel. Option 2: Duncan Tech.</p> <p>Option 3: Zeiss; Leitz (cameras); Kodak (film, filters)</p>	

Additional Overflights: Aerial Gamma Spectroscopy [Protocol, Part II, paragraph 80]		
<p>Characteristics of Target Anomaly:</p> <p>The target is manmade radiation anomalies above background on the surface from an atmospheric nuclear explosion or from a UNE. Verify there are no unsafe ionizing conditions during this period of time on the surface within the inspection area.</p> <ul style="list-style-type: none"> • 70 to 1600 KeV 	<p>Functional Requirements:</p> <p>The objective is to scan the earth's surface from an aircraft to detect regions of elevated gamma radiation due to human activities, and to locate areas of elevated background. The system will consist of a broadband low-resolution detector such as a sodium-iodide detector. The equipment should be capable of measuring a spectrum of 70-3200 KeV with 512 channels and a sampling time faster than 2 seconds using a sodium-iodide detector of 16-32 liter volume. The system should be capable of detecting an equivalent point source of ^{137}Cs or ^{241}Am at levels of tens of Bq/Kg. In the data processing, normalization, windowing should be available to determine the energy contributions from ^{40}K and the ^{238}U-^{232}Th series for measuring background level variations, and separating out the manmade energy contributions (70-1600 KeV).</p>	<p>Comments</p> <p>Energy monitoring and detecting of hot spots from any source (e.g., geological), or spectrometry and determining if natural or man-made radioelements. Natural variations from geologic terrains may introduce clutter and complicate any identification.</p> <p>(comments added after workshop:</p> <p>To detect ^{241}Am, the range needs to be extended to below 60 KeV; tens of Bq/Kg may be a difficult target, it would be better to propose tens to hundreds of Bq/Kg; and acquisition time of "around" 2 seconds would be less stringent and perhaps more realizable.)</p>
<p>Summary of Workshops:</p> <p>30 to 3200 keV, performance depends upon energy, altitude, velocity, volume, sampling time, offset distance, radioelements to be detected [CTB/OSI/WS-5/PR/25].</p> <p>16 to 32 liter NAI detector, radio-altimeter, 512-channel spectrometer, hardened PC, mass storage, GPS, pilot display and altimeter for navigation, anchor supports for aircraft, software to determine spectrum and display, calibration methods, detection limits and procedures. [CTBT/PC/III/OSI/PR/15/Add.1]</p> <p>Performance Estimates. [CTBT/PC/III/OSI/WS/PR/16/Add.2]</p> <p>Energy monitoring or spectrometry? [CTBT/PC/V/OSI/WSII/PR/19]</p> <p>Altitude 60-100m, less than 100 km/h [CTBT/PC-7/OSI/WS-3/PR/33]</p> <p>Low-resolution NaI, less than or equal to 4 channels. Question of the need for "blinding." [CTBT/PC-</p>		<p>(comment added after workshop:</p> <p>Whether this equipment will be used by a specialized team or by inspectors was not discussed in this workshop but during previous ones. How the OSI Operational Manual is written for this equipment will depend on this question.)</p>

Additional Overflights: Aerial Gamma Spectroscopy [Protocol, Part II, paragraph 80]	
<p>7/OSI/WS-3/PR/8]</p> <p>NaI only able to identify most prominent gamma emitters. Three signals: sum of all detectors for single spectrum with high sensitivity; one detector for lower sensitivity; smaller detector for still lower sensitivity. Man-Made Gross Count map (MMGC) most valuable, then spectral-stripping for areas with significant MMGC.[CTBT/PC-7/OSI/WS-3/PR/13]</p> <p>Reference:</p> <p>Final Procurement Specifications for Radionuclide Survey and Analysis Equipment for On-Site Inspection: Hand-Portable Gamma Search Tool for Testing Purposes, [CTBT/PTS/INF.295].</p>	
<p>Specifications:</p> <p>The system should consist of the detector in a certifiable aircraft pod (16 to 32 liters NaI detector or equivalent using 512-channel PMT system). These specifications should be consistent with CTBT/PTS/INF.295. Radio-altimeter, GPS based recording integrated to acquisition system and pilot display and altimeter for navigation. Digitally recorded on hardened PC, mass storage, anchor supports for aircraft (although can be mounted inside). Mount on aircraft (weight, style of mount, etc), software for MMGC and spectral stripping with visualization as found in the field information management system (FIMS).</p>	<p>Needs temperature and pressure measurements to calculate air mass for normalization calculation.</p> <p>Same GPS unit can be used with all aerial measurements if designed for these applications.</p>
<p>Procedures:</p> <p>Flight: The ideal is approximately 100 km/h, 100m altitude or less depending upon terrain and safety conditions, offsets from 50 to 500m between tracks, 2 seconds or less acquisition time for 70 to 3200 KeV. Compare to ground-based and aerial visual photography and human observational experience to eliminate associate obvious effects due to known cultural features or geology.</p> <p>See CTBT/PC-7/OSI/WS-3/PR/13 and CTBT/OSI/WS-5/PR/25 for details. Good description in: http://www.hsk.psi.ch/portraet/projekte/aeroradiometrie/airborne%20surveys/airborne%20surveys.htm</p>	<p>This technology can be flown on its own or with others, but it may change the flight and data acquisition parameters to less than optimum.</p> <p>Increasing the flight speed or height decreases the sensitivity and resolution.</p>
<p>Examples of Manufacturers:</p> <p>Exploranium G.S. Ltd; VIRG - Rudgeophysics, St. Petersburg, Russia.</p>	

Additional Overflights: Magnetic Field Mapping [Protocol, Part II, paragraph 80]		
<p>Characteristics of the Target Anomaly</p> <p>Targets for detection include buried ferrous objects associated with drill pipe, drill-hole casing, shallow-buried metal artifacts and other ferrous material associated with an UNE or its testing.</p>	<p>Functional Requirements:</p> <p>The objective is to identify, from an aircraft survey, spatially limited magnetic anomalies related to buried ferrous objects such as drill pipe, drill-hole casing, shallow-buried metal artifacts, etc. Variation in the local magnetic field due to geology can be hundreds of nT or more over distances of hundreds of meters to kilometers. The equipment should be able to measure total magnetic field strength over a range of 30,000 to 100,000 nT with 1 nT or better accuracy with high stability at sampling rates of 10 Hz. When carrying out any magnetic survey, use of a second magnetometer allows correction for diurnal changes of the magnetic field; thus a minimum of two instruments will be needed for an OSI. Base station can be the same as used for the ground survey.</p>	<p>Comments</p> <p>Can be compromised in rugged areas, where difficult to maintain a constant height above the terrain.</p>
<p>Summary of Workshops:</p> <p>Stinger or towed from low-speed aircraft with real-time visualization and software analysis. Recording of navigation information. [CTBT/OSI/WS-4/PR/32]</p> <p>At 50 m, maximum amplitude of ΔT is 200 to 300 nT, maximum gradient is 10 nT/m, and dimensions of anomaly are 350 to 500 m over a borehole. [CTBT/OSI/WS-5/PR/17]</p>		<p>Airborne surveys combine three sensors at once: magnetic, multi-spectral, and radiometric. Similar navigation requirements for all overflight technologies.</p>
<p>Specifications:</p> <p>Mount on aircraft (weight, style of mount, etc), typically as a stinger for fixed-wing, or mounted as a towed-bird for helicopter. Digital acquisition, same sensitivities as stated above. Software: reduction and analysis software to evaluate source of anomaly, digital filtering, image processing.</p> <p>Option a) Fixed Wing Stinger</p>		<p>What is the ease of mounting for bird vs. stinger? Stinger can be used with helicopter but requires special compensation, and some limitations to sampling rate might occur.</p>

Additional Overflights: Magnetic Field Mapping [Protocol, Part II, paragraph 80]

Advantages:

Fast surveying capabilities; ease of integration with other airborne techniques (e.g. electrical conductivity, radiometric ...etc.)

Disadvantages:

It needs a compensation system based upon a fluxgate magnetometer in the aircraft aimed at the measurement of the three components of the magnetic field produced by the aircraft, to be removed from the survey measurements. If option (a) is adopted, then real time compensation software is strongly recommended.

Option b) Helicopter tow bird

Advantages:

This configuration is typically seen for helicopters; however fixed wing aircraft provided with a winch may tow birds with sensors. This avoids compensation devices and interpretation. Helicopter surveys have the advantage to slow down the survey speed, to reduce the altitude at minimum and to perform draped flights, when the topographic surface permits. Towed bird configuration allows to investigation of the inspected area by reducing the terrain clearance, i.e. the distance from the magnetic sources.

Disadvantages:

Fixed wing aircraft would require a substantial structural modification for the installation.

Some countries may not allow towed birds.

Data reduction

After the survey, data have to be backed up and transferred to a workstation in the field. The airborne data shall be linked to the magnetic and the GPS base station data.

The data reduction procedure consists of a series of steps:

- flight path repositioning;
- differential GPS processing;
- detection and elimination of spikes due to hardware noise;
- diurnal variation correction;
- computation of the anomaly field (subtracting a reference field value);
- levelling (crossover analysis)
- data gridding and contouring;

Both the setups require certification from local aeronautical authorities (i.e. Civil Aviation, Aeronautical Register, etc.) and slight modifications to the flight manual. All these procedures usually require time. Procurement of airborne devices already certificated in most of the countries may speed up these procedures.

A unique software providing all-in-one the reduction and interpretation techniques is recommended.

Additional Overflights: Magnetic Field Mapping [Protocol, Part II, paragraph 80]	
<ul style="list-style-type: none"> • mapping and visual representation. <p>Interpretation and modeling:</p> <p>These techniques require specific software. In the field inspectors ought to be able to:</p> <ul style="list-style-type: none"> • perform potential field data processing (analytical continuation of the field, reduction to the pole, etc.); • digital filtering • estimate the depth of the potential magnetic sources (Euler deconvolution method, Spector and Grant etc.); • perform magnetic modelling; developing sections. 	<p>Similar processing techniques can be applied to both magnetic and gravity data.</p>
<p>Procedures:</p> <p>Surveys usually carried out on a rectangular grid of flight lines and tie lines. Line spacing and flying height have a critical effect on the resolution of anomalies. Undesired cultural noise or geologic anomalies can be a problem. Line spacing 100-400 m, and height 30-100 m using low-speed aircraft.[CTBT/OSI/WS-4/PR/32]</p>	
<p>Examples of Manufacturers:</p> <p>GEM Systems Inc.; VIRG - Rudgeophysics, St. Petersburg, Russia; Scintrex; RMS Instruments; GeoSoft Inc.</p>	

Additional Overflights: Aerial Location [Protocol, Part II, paragraph 80]		
Characteristics of Target Anomaly:	Functional Requirements: Altitude measurements and monitoring to 1-meter accuracy for aerial gamma needed for data reduction. Ability to follow flight path to 10 meters (horizontal deviation) and record information with data in acquisition system. Pilot display indicator assists the pilot in maintaining flight course and image or data acquisition control. In-flight control for the following scene or acquisition spacing along the line, line spacing, and flight-line grid. Integration with field information management system (FIMS) or acquisition system for data.	Comments Same GPS unit can be used with all aerial measurements if designed for these applications. Terrain following not necessary. Assumes minimum 100 m line spacing. Aircraft systems typically not designed to be integrated with acquisition system.
Summary of Workshops:		
Specifications: Option 1: GPS based system. <input type="checkbox"/> Self-contained system includes differential GPS and a system to record precise image centers. The guidance software provides pre- planned flight lines, with centers and overlaps, as well as in-flight planning <ul style="list-style-type: none"> • a laptop for guidance and system management • GPS based recording integrated to acquisition system and pilot display and altimeter for navigation • referenced to base station Option 2: Radio beacons, locally installed for survey		Question of availability. Beacon system potentially expensive and time consuming to install, requires local batteries or

Additional Overflights: Aerial Location [Protocol, Part II, paragraph 80]	
<ul style="list-style-type: none"> • GHz frequencies (expensive) • Requires survey location for each beacon • The flight location based on beacons should be recorded on the data acquisition system. • Accuracy in the order of 1 meter relative to the beacons (more beacons give better accuracy). • Relative locations of beacons must be known to 1 meter. <p>Option 3: Using aircraft navigation system</p> <ul style="list-style-type: none"> • Requires integration with data acquisition system • Additional certification maybe necessary for aircraft 	<p>power, requires line-of-sight to aircraft.</p> <p>At least 3 beacons must be seen at all times by the aircraft. More maybe necessary to achieve 1 meter accuracy.</p>
<p>Procedures: An example of how airborne positioning data is integrated into a radiometric survey similar to what might be carried out during an OSI additional overflight can be found at:</p> <p>http://www.hsk.psi.ch/portraet/projekte/aeroradiometrie/airborne%20surveys/airborne%20surveys.htm</p>	
<p>Examples of Manufacturers:</p> <p>GPS based system for overflight data acquisition: Exploranium G.S. Ltd.</p>	

Resonance Seismometry [Protocol, Part II, paragraph 69f]		
<p>Characteristics of Target Anomaly:</p> <p>The target anomaly is the explosion cavity, or its rubble and fracture zone, and excavated cavities. A cavity could be 30-50 m in diameter and located from 100 to 1000 m or more beneath the surface.</p> <p>The measured parameter is velocity of surface sites, expressed as the spectral density. The anomaly typically is in the 10 to 30 Hz range, where the spectral density increases by a factor of 2 to 3 above background over a broad dome, roughly of radius of the rubble zone/cavity.</p>	<p>Functional Requirements:</p> <p>The objective is to measure the spatial variation in near-surface seismic wave propagation along near-vertical paths from distant sources, which may be caused by an underground rubble chimney, explosion cavity, or excavated cavity due to an underground explosion. A cavity could be 30-50 m in diameter and located from 100 to 1000 m or more beneath the surface. The equipment to be used for resonance seismometry is the same as that employed for passive seismic surveys during the initial period of an OSI, but some additional data processing software will be used. The software will be capable of analyzing subtle differences between waveforms of compressional, shear, and other seismic phases as measured from a common distant seismic event on closely spaced (tens of meters separation) seismometers.</p>	<p>Comments</p> <p>5 square kilometer area is considered realistic for this application.</p> <p>Comment added after workshop:</p> <p>Functional requirement should include capability of up to 1000 Hz (1 ms) sampling rates.</p>
<p>Summary of Workshops:</p> <p>Uses spectral composition of microseism background and influence of cavity/rubble zone on spectral amplitudes. Accuracy of 50 to 100 m. Requires 5 people, 4 days over 5 sq-km area, if topographic survey already done. Same equipment as passive seismic with possibly some additional software.[CTBT/PC/OSI/WSII/PR/13]</p> <p>Useful in areas with no aftershocks of UNE and result of seismic resonance in cavity and distortion of microseisms by cavity/rubble zone. Increase in spectral density at frequencies characteristic of heterogeneity, its depth and distance. Anomaly typically in 10 to 30 Hz range, and is an increase of spectral density by a factor of 2 to 3 above background over broad dome, roughly the radius of rubble zone/cavity. [CTBT/OSI/WS-5/PR/17]</p> <p>Shadow introduced by cavity from reflections seen in ratio of seismic amplitudes. Might be possible to use slow sweeps with vibroseis to capture resonant frequency [CTBT/OSI/WS-5/PR/11]</p>		<p>Further research results are pending.</p>

Resonance Seismometry [Protocol, Part II, paragraph 69f]	
Specifications: Same as passive seismic equipment, but may require additional seismometers and sites.	Comment added after workshop: Sampling rate should be a minimum of 1000 Hz.
Procedures: Establish permanent site at edge of area of interest. Care to avoid poor local site conditions. Deploy grid of instruments with separations of 50 meters or less on uniform geology if possible, record background seismicity and regional events from different directions. Compute spectral ratios and determine if “shadow” shifts on surface with direction of event/noise.	Shallow 1 meter deep holes used for seismometers.
Examples of Manufacturers: Equipment used for passive seismic recording.	

Active Seismic Methods [Protocol, Part II, paragraph 69f]

Characteristics of Target Anomaly:

The target anomaly is the explosion cavity and fractures surrounding it, its rubble zone, any apical void above it, and excavated cavities. Dimensions of the target range from tens of meters in diameter, but may extend up to several hundred meters toward the surface. A cavity could be 30-50 m in diameter and located from 100 to 1000 m or more beneath the surface.

Functional Requirements:

Active seismic methods determine spatial changes in the properties of seismic wave propagation using a controlled seismic source and a single or an array of geophone receivers; these must be interpreted to understand the structure. Geophones should detect frequencies up to 200 Hz and the recording system should be capable of sampling rates up to 1 millisecond (1000 Hz). The active seismic source is typically a truck vibrator, explosives, or perhaps a dropped weight or sledgehammer. The entire source and data collection system should be easy to deploy under a wide range of conditions. The cavity may not be detected directly, but instead the rubble zone and fractures surrounding the cavity.

Comments

The controlled source requires sufficient energy to observe reflections and diffractions from small structures at the target depth with sufficient acoustic contrast, and be at sufficiently high frequency (e.g. >100 Hz) to resolve small targets. If a source is repeated and waveforms are stacked, the source waveform must be repeatable at these high frequencies. An explosive source with sufficient energy for good signal to noise at the expected depth may be best for detecting the anomalous zone.

Comment added after workshop:

Seismic source should be capable of producing up to 100 Hz with sufficient energy for recording.

Summary of Workshops:

Seismic refraction might detect cavity if receivers and sources are laid out as fan.. Seismic reflection is designed for the target depth. Small system (48 channel) if works require expert for analysis and interpretation, blaster, and from 4 to 8 personnel to conduct deployment. [CTBT/PC/V/OSI/WSII/PR/15]

Need strong source to penetrate hundreds of meters and dense array of stations (less than 10 m separation). Equipment is heavy and may limit application. [CTBT/PC/V/OSI/WSII/PR/10]

Using 48-channel system deployed at edges of area (2x2 km) as fan, and sources as a fan, can do tomography of area between sources and receivers. Detect diffracting objects to error of 150 m. Requires 5 days for 7 personnel, excluding topographic survey activities. [CTBT/PC/V/OSI/WSII/PR/13]

The equipment, source, and procedures depend upon the complexity of the subsurface geology, and is greatly assisted by any existing data bases, including previous surveys.

The results of an active seismic survey (e.g. velocity structure) can

Active Seismic Methods [Protocol, Part II, paragraph 69f]	
<p>Active seismic methods should be optimized for relevant depth, and shallow layers masked from operator's view, or removed before releasing. [CTBT/PC-7/OSI/WS-3/PR/8]</p> <p>Using 3-D seismic, investigate area of 1x1 km requires survey over 3x3 km, 100 people for 2 weeks or 25 for 6 weeks. Equipment includes 3 vibrators, 4 light vehicles, 6 pickups, 2 trucks, and recording lab. Sources used every 100 m, and real-time processing. [CTBT/OSI/WS-4/PR/22]</p> <p>3-D acquisition desirable using state-of-the-art seismic reflection equipment as used for oil and gas exploration.[CTBT/OSI/WS-4/PR/4]</p> <p>In complex geology, 3-D acquisition and analysis is necessary to resolve diffracted image of cavity and rubble zone. Source requires high frequencies then, e.g. 100 Hz. [CTBT/OSI/WS-4/PR/3]</p> <p>Resolution insufficient to detect past UNE at NTS in alluvium (attenuation of signal). Shear velocities affected over much larger volume than compressional velocities. [CTBT/OSI/WS-4/PR/21]</p> <p>Detecting alteration using diffracted waves caused by UNE. Dimensions of anomaly 100 m. [CTBT/OSI/WS-5/PR/17].</p> <p>Experienced personnel necessary. Fracturing larger than cavity itself and maybe detected using oil and gas reflection methods. Needing resolution of 10m at 500 m depth determines frequency. Standard 500 channel system using 3-D methods (2-D array over surface). Details in paper. [CTBT/OSI/WS-5/PR/30]</p> <p>Localized search for cavity requiring seismic source (vibrator or explosives), single-component seismometer (5-250 Hz), seismograph for data recording, and processing and display software and hardware. Limited by geological heterogeneities. [CTBT/OSI/WS-6/PR/11].</p> <p>High frequencies (100 Hz) are suggested, and systems using 124 geophones might be sufficient if 3-D acquisition is used for fracture detection around the cavity. The essential elements are: source with sufficient energy to get reflections at 100 Hz; compatible geophone, cables, seismograph, storage media, GPS for 1 meter location, data processing software, data interpretation software, and mapping/visualization tools. Experiments are underway in Iran that may better define these requirements. [CTBT/OSI/WS-6/PR/17]</p>	<p>help improve event locations of a passive seismic survey.</p>
<p>Specifications:</p> <p>Minimum 124 channels, capable of both refraction and reflection acquisition, minimum 124 db dynamic range, at least 1 ms (1000 Hz) minimum sampling rate, time base minimum 1 ms error between channels, 32 bit stacking for repeated source, built-in software for first arrivals and quality control, 12 V power. 3-C seismic acquisition maybe important to detect fracturing. Designed for field application in a variety of</p>	<p>Full 3-D seismic reflection system as used in oil and gas exploration is not practical; instead, the recommendation is based on shallow to medium depth target acquisition. A 124 channel system can be</p>

Active Seismic Methods [Protocol, Part II, paragraph 69f]	
<p>environments (e.g., -40 to 50°C). PC compatible with software for applications using a vibrating source, refraction analysis and modeling, velocity analysis using reflection methods, filtering and signal analysis needed for reflection applications, reflection processing including NMO, CMP, and migration. Capable of 3-D processing.</p> <p>Seismic energy sources capable of 100 Hz energy and have sufficient energy to penetrate to expected depth. Geophones are selected for high frequency application and may include 3-component geophones that are necessary for shear wave analysis (fracture definition).</p> <p>Interpretation and mapping software compatible with selected equipment.</p>	<p>adapted to a variety of field conditions.</p>
<p>Procedures:</p> <p>Standard 2-D and 3-D acquisition for expected depth of event. Energy source compatible with expected depth and geologic medium.</p>	<p>Near surface (<100m) data is needed for processing, but could be removed from the final display (not special modifications to the software other than not printing final section with near- surface).</p>
<p>Examples of Manufacturers:</p> <p>Geometrics, Inc for portable systems</p>	

Magnetic Field Mapping [Protocol, Part II, paragraph 69g]		
<p>Characteristics of Target Anomaly:</p> <p>The target is the buried or surface ferrous objects associated with an UNE including drill pipe, drill-hole casing, and shallow-buried metal artifacts.</p>	<p>Functional Requirements:</p> <p>The objective is to identify from a ground-based survey spatially limited magnetic anomalies related to buried ferrous objects such as drill pipe, drill-hole casing, shallow-buried metal artifacts, etc. Variation in the local magnetic field due to geology can be hundreds of nT (gammas) or more over distances of hundreds of meters to kilometers. An anomaly will be a change in total magnetic field of hundreds of nT or more over distances less than 100 m. The equipment should be able to measure total magnetic field strength over a range of 30,000 to 100,000 nT with a 0.1 nT accuracy with high stability at sampling rates of one second or faster in both regular and gradiometric configurations. When carrying out any magnetic survey, a second magnetometer must be used to measure diurnal variation of the magnetic field variation at a fixed location near the survey site; thus a minimum of two instruments will be needed for an OSI. The equipment should be portable with a device to insure that each measurement is taken at one or more common, known elevations relative to the earth surface.</p>	<p>Comments</p> <p>Near-surface artifacts, casings, cabling.</p> <p>Some geological conditions create difficult conditions, e.g., volcanic terrain or dike intrusion.</p>
<p>Summary of Workshops:</p> <p>Metallic targets to 50m depth, depending upon size, with line spacing or 1/2 to 1/4 or size of target, sampling every 1/2 second. Require measurements to be easily recorded and software for visualization on a map. Acquisition by walking at 2.5 to 5 km/h maximum, with real-time processing. [CTBT/OSI/WS-4/PR/22].</p> <p>Measured parameter is modulus of overall vector of magnetic field T at the earth's surface in the range 25000 to 120000 nT. Parameter characterizing amplitude of magnetic anomaly is an increment DT, obtained via subtraction of background value and magnetic field variations. Measure 25,000 to 120,000</p>		

Magnetic Field Mapping [Protocol, Part II, paragraph 69g]	
<p>nanoTeslas (nT). Measurement over borehole (cased) gives anomaly ΔT (intensity) from 16000 to 56000 nT, and distinct gradients of 25,000 to 44,000 nT over 50 to 350 m. For UNE performed in the hole, maximum amplitude of ΔT is 16000 to 56000 nT and planar dimension of values $\Delta T > 50$ nT from 50 to 350 meters. [CTBT/OSI/WS-5/PR/17]</p> <p>Fast qualitative shallow mapping for first investigation and delineation. 10m spacing and 10 km/day. Good for metallic body targets such as buried pipe. Resolution 1 nT, 1 fixed magnetometer for recording diurnal variations, 1 portable magnetometer with gradiometer option, 0.5-second sampling rate, processing computer, analysis and display software. Requires 1 operator and 1 geophysicist for interpretation. [CTBT/OSI/WS-5/PR/30]</p> <p>Detect and locate ferrous artifacts shallower than 30 meters. Requires magnetometer, console with storage and graphics display and sensor. Needs relative sensitivity of ~ 0.2 nT and absolute accuracy of ~ 1 nT. The method is not sensitive to any changes in magnetic field induced directly by an underground nuclear explosion. [CTBT/OSI/WS-6/PR/11]</p>	<p>Comment added after workshop:</p> <p>2 Hz sampling rate probably sufficient for fixed magnetometer.</p>
<p>Specifications:</p> <p>Optically pumped (Potassium/Cesium) magnetometer with minimal heading error or orientation error, 30,000 to 100,000 nT with 0.1 nT accuracy, with high stability at sampling rates of 1/2 second or better. Ability to acquire data continuously at discrete time intervals at fast walking pace or vehicle mounted (10 Hz sampling). All necessary mountings and batteries for personnel. Gradiometer staff. Acquisition unit/console for data storage, retrieval, functionality tests, and graphical review in real-time. Any necessary navigation features to accept differential GPS. Base station unit is necessary. PC and software designed for acquisition of data, downloading of data, and analysis software with modelling capabilities.</p>	<p>Off-the-shelf system used in geophysical exploration.</p> <p>Using differential GPS allows very rapid acquisition of data (10 times faster). One meter relative accuracy needed for measurement sites.</p> <p>Proton magnetometer is adequate for base station because of slower sampling rate and is less expensive.</p>
<p>Field procedures unique to OSI for data acquisition:</p> <ul style="list-style-type: none"> The measurements can be carried out along profiles at discrete intervals (walking operator) or continuously (vehicle mounted). In both cases procedures are the same. The measuring grid spacing shall be defined in advance. Each magnetic measurement shall be associated to a positional information (deriving from a portable GPS acquisition unit). A magnetic base station shall be installed at a fixed location in the survey area (far from electromagnetic disturbances) to monitor the Earth's magnetic field variations. These variations shall 	

Magnetic Field Mapping [Protocol, Part II, paragraph 69g]	
<p>be removed (diurnal variation correction) from the raw data acquired along the profiles.</p> <p>Data reduction</p> <p>After the survey, data have to be backed up and transferred to a workstation in the field. The ground magnetic data shall be linked to the magnetic and the GPS base station data.</p> <p>Data reduction procedure consists of a series of steps:</p> <ol style="list-style-type: none"> 1. profile positioning; 2. differential GPS processing; 3. diurnal variation correction; 4. computation of the anomaly field (subtracting a reference field value); 5. data gridding and contouring (with appropriate parameters related to the grid spacing); 6. mapping and visual representation. <p>Interpretation and modeling</p> <p>Interpretation and modeling require specific software. In the field, inspectors ought to be able to:</p> <ul style="list-style-type: none"> • perform potential field data processing (analytical continuation of the field, reduction to the pole, etc.); • digital filtering in the time and frequency domain; • estimate the depth of the potential magnetic sources (Euler deconvolution method, Spector and Grant etc.); • compute magnetic models; develop sections. 	<p>A unique software providing all-in-one the reduction and interpretation techniques is recommended.</p> <p>Similar processing techniques can be applied to both magnetic and gravity data.</p>
<p>Examples of Manufacturers:</p> <p>Geometrics, Inc., GEM Systems, Inc., Scintrex</p>	

Gravitational Field Mapping [Protocol, Part II, paragraph 69g]

Characteristics of Target Anomaly:

The targets are excavated cavities or apical voids above a rubble chimney.

Functional Requirements:

The objective is to detect and identify from a ground-based survey spatially limited gravitational anomalies related to spatially limited, negative gravity anomalies above an underground excavated cavity or apical voids above a rubble chimney. The terrain corrections to gravity data require sub-centimeter precision for elevation surveys. Natural variation of the gravitational field is on the order of tens to hundreds of mgal over distances of hundreds of meters. The measurement equipment must be capable of μ gal precision and be stable over a range of operating temperatures. Gravitational anomaly data is best interpreted in conjunction with results from the other methods listed in Protocol, Part II, paragraph 69, especially magnetic field mapping.

Comments

Gravity measurements require significant effort and time for both gravity and elevation measurements. Need to survey gravity and elevation at decreasing accuracy over an area 5 times greater in each direction to allow for terrain corrections. This is the least effective method for the detection of artifacts, but only method other than active seismic to detect an underground cavity. Geologic noise complicates interpretation.

Sub-centimeter elevation measurements require differential GPS with 1/2 hour acquisition at each gravity station. Optical survey is viable alternative, but also time consuming. Elevation and position reference to arbitrary site that acts as base reference station for gravity. Must re-measure base station at least every 2 hours for tidal gravity correction.

(comment added after the workshop) The elevation data in overall context of the regional terrain may reveal local subsidence related to an underground cavity; this will be a source of information in itself about the possibility of an explosion site being present.

Gravitational Field Mapping [Protocol, Part II, paragraph 69g]	
<p>Summary of Workshops:</p> <p>Anomaly is ring-shaped of alternating sign, ranging from 0.03 to 0.06 mgal (no excavation) with dimensions of 150 to 600 m. Need accuracy of single measurement below 5 microgal. Difficult measurements and high labor cost. Relief corrections and heterogeneity problem. [CTBT/OSI/WS-4/PR/10, CTBT/OSI/WS-5/PR/17].</p> <p>Resolution 1 microgal with centimeter surveying for elevation. 2 field personnel and 1 geophysicist for interpretation. [CTBT/OSI/WS-5/PR/30]</p> <p>Requires settling for 2 days after travel and against base reference every 2 hours, target size/depth greater than 1/2 with density contrast greater than 0.5, grid spacing less than depth, topographic and tide corrections. [CTBT/OSI/WS-4/PR/22]</p> <p>Not suitable for mountain sites with severe relief and required 1 cm elevation accuracy, accurate time recording, base point for comparison, spacing between sites less than targets dimensions. [CTBT/PC/V/OSI/WSII/PR/15]</p> <p>Useful for shallow cavities and collapses less than 30 meters in depth. Requires absolute accuracy of 10 microgal. Limited by complicated geological conditions and unknown mass distribution. [CTBT/OSI/WS-6/PR/11]</p>	
<p>Specifications:</p> <p>Gravimeter, sensitive to less than 1 microgal, 0 to 50°celsius operating environmental temperature range. Instrumental drift no more than 1 mgal per month, self-leveling, automated real-time acquisition and tidal corrections, integrated data logger, electronic storage of data and display, interface to computers, less than 10 kg, operate for 8 hours or more with battery when temperature stabilized. Options for operation to -40° Celsius. Option to improve sensitivity to 0.1 microgal if deemed necessary. Software tools for complete data reduction and display. Interpretation and modeling use same potential field modeling software as used in conjunction with magnetic field mapping.</p>	Automated digital system would speed acquisition.
<p>Procedures:</p> <p>Correction for tides using base station, elevation (free-air), topographic relief (terrain correction), density/thickness of rocks (Bouguer). Geological heterogeneity complicates interpretation at microgal level.</p>	Mapping and processing software can be the same as for magnetics.
Examples of Manufacturers:	

Gravitational Field Mapping [Protocol, Part II, paragraph 69g]	
Lacoste-Romberg, Scintrex, Gravmaster software.	

Ground Penetrating Radar (GPR) [Protocol, Part II, paragraph 69g]		
<p>Characteristics of Target Anomaly:</p> <p>The target anomaly are:</p> <ul style="list-style-type: none"> buried artifacts of UNE including cables, pipelines, and construction debris, and fractures associated with the explosion. 	<p>Functional Requirements:</p> <p>The objective is to detect shallow, spatially limited subsurface changes in radar reflectance related to buried artifacts, faults or large fractures covered by soil. To achieve depth of penetration of radar energy to 10-20 meters for a range of conductivity from variable clay content, moisture content, or geology, a system using a variety of frequencies should be used. This will require a system with 5-6 antenna sets covering a frequency range of 20-500 MHz with the highest power output that is available. The equipment should include an integrated workstation with software capable of creating time section displays. Data is best interpreted in conjunction with results from other methods such as magnetic field mapping and electrical conductivity.</p>	<p>Comments</p> <p>Visibility of fractures requires further documentation and/or research.</p> <p>Experts agree that a maximum detection depth of 20 meters is realistic under most geologic conditions.</p>
<p>Summary of Workshops:</p> <p>Useful for near surface artifacts or changes over rectangular grid. Usefulness governed by surface electrical properties and contrasts. Clay minerals often dominate properties; ground is highly unfavorable medium for propagation. Depending on properties and frequency, penetration up to 100m depth. Frequencies range from 50 MHz (50m max penetration) to 300 MHz (10m max penetration). Simple dipole and folded dipole antennas. Processing similar to reflection seismic, except specialized for GPR. [CTBT/PC/V/OSI/WSII/PR/15]</p> <p>Acquisition must be optimized in consultation with ISP to account for confidentiality concerns.[CTBT/PC-7/OSI/WS-3/PR/8]</p> <p>Capable of detecting voids, easy to use, and can be done in short time. Penetration depth is limited and transmitted signal frequency may require authorization. Surface scans require relatively smooth and flat surface[CTBT/OSI/WS-4/PR/11]</p> <p>Target size/depth greater than 1/10 (shallow) to 1/2 (deep). Line spacing of 1.5 m with continuous</p>		

Ground Penetrating Radar (GPR) [Protocol, Part II, paragraph 69g]	
<p>acquisition. Requires good coupling, thus, level surface. Acquire at 2 to 4 km/h. [CTBT/OSI/WS-4/PR/22]</p> <p>Semi-quantitative method for shallow mapping to improve depth resolution and target location. Applied to anomalous areas identified by qualitative methods. Line spacing 5 m plus narrower on specific spots. 5 to 6 antenna sets ranging from 20 to 900 MHz for different depths and ground parameters. Processing workstation with correct software for time section displays and other functions. Three (3) field personnel and one (1) geophysicist skilled in interpretation. [CTBT/OSI/WS-5/PR/30]</p> <p>Objectives are artifacts at depths less than 30 meters, or detecting subsurface faults/fractures for sampling. Requires control unit, EM transmitter and receiver (20 MHz to 1 GHz), operating and data processing software. Limited by thick surface soil cover and extensive vegetation, blocking subsurface geological layers, external EM disturbances, and scattering of EM wave by ground surface and environmental objects. [CTBT/OSI/WS-6/PR/11].</p>	
<p>Specifications:</p> <p>Frequency range 20 MHz to 500 MHz or higher. 16-bit acquisition, CMP profiling. Pulse repetition frequency 100 kHz or higher, sampling rate, 200 scans/s, performance 150 db or more, stacking, -10 to 50 °C or more, high-power transmitters for low-frequency antennas or optimum performance and deep penetration, shielded antennas preferred, portability given antenna size and useful power, designed for field acquisition. Multi-antenna, multi-channel useful. Field acquisition computer as necessary. Hip chain for position control in poor terrain. Software for data reduction, analysis (e.g., filtering) and display / visualization including velocity determination, migration, and 2D modeling programs designed for radar application.</p>	
<p>Procedures:</p> <p>Rectangular grid laid out, smoothed for good contact. Geology determines acquisition and depth of penetration, using manufacturer's instructions as guidance. Normally walked unless terrain allows mounting on a vehicle.</p>	Cannot be used in rough terrain or highly conductive material.
<p>Examples of Manufacturers:</p> <p>Sensors and Software, Inc. (PulseEkko PGR); RAMAC/GPR, Mala GeoScience AB, GSSI, Zhukovsky</p>	

Electrical Conductivity Measurements [Protocol, Part II, paragraph 69g]		
<p>Characteristics of Target Anomaly:</p> <p>Target anomalies may separate into two groups, shallow (~20 m) and deep, and are associated respectively with metallic artifacts including buried conductors, and subsurface changes induced by the explosion, its cavity or rubble zone, or from an excavated cavity. Anomaly could be either positive or negative, depending upon local conditions.</p>	<p>Functional Requirements:</p> <p>To minimize intrusiveness and allow for simplified operations, controlled-source time domain electromagnetic methods are preferred. For shallow (1-50 m) depth investigations, a portable battery-powered induction field ground conductivity instrument (such as TDEM and TEM) capable of 0.1% precision at full scale over ranges of ± 10, ± 100, ± 1000 mS/m (1 milliseimens/meter is equivalent to 1000 ohm-m) is preferred. For deep (50 m – 2 km) investigations, the equipment should be capable of performing controlled source audio and sub-audio frequency magnetotelluric or transient electromagnetic measures (TEM) with a high-power (several kilowatts) generator and controller. This equipment should be capable of operating over frequencies of 0-8 kHz in sounding or profiling mode. Data from shallow subsurface changes will best be interpreted in conjunction with results of GPR and magnetic field mapping surveys; data from deep targets are best interpreted with results from active seismic or resonant seismic surveys.</p>	<p>Comments</p> <p>Same equipment can be used in different configurations, either as transient or frequency mode, to adapt to local conditions.</p>
<p>Summary of Workshops:</p> <p>DC resistivity to detect cavity in shallow stratum, but can only reach 200 to 300 m under ideal conditions. TEM (transient electromagnetic) method may have observed deep cavities. [CTBT/PC/V/OSI/WSII/PR/10]</p> <p>Electrical sounding applied to 5-sq km search area. Useful for conducting body within more resistive rock mass. Inductive EM methods, resistive and polarization anomalies with non-polarizing electrodes. Arrangement of electrodes important. [CTBT/PC/V/OSI/WSII/PR/13]</p> <p>Electrical measurements require conductivity resolution of 1 milliseimens and resistivity to 1 ohm meter. Frequency range for shallow targets of 15 to 50 kHz, and deeper targets of 1 to 15 kHz. Data logger capacity greater than 2 Mbytes at 1 s. Require processing computer and software for conductivity and resistivity profiles and maps. Two (2) field personnel and 1 experienced geophysicist. [CTBT/OSI/WS-5/PR/30]</p> <p>Conductivity measurements typically less than 50m depth. For cables, target size/depth greater than 1/10.</p>		<p>Controlled sources are preferred to DC resistivity methods.</p>

Electrical Conductivity Measurements [Protocol, Part II, paragraph 69g]

For 3-D targets, target size/depth greater than 1/4. Line spacing of 1/2 to 1/4 the size of the target. Continuous acquisition advised. [CTBT/OSI/WS-4/PR/22]

Spontaneous potential method (or self-potential SP) use no active source and detect naturally occurring currents associated with subsurface flow of heat or fluid. Easy-to-make measurements, difficult to interpret and best with simple subsurface geology. Need locations to 5 m. Accuracy of 5 mV desired, background noise 10 mV, and anomalies in geothermal field range from 50 to 2000 mV. Anomalies measured at UNE are donut and range from 20 to 80 mV, still detectable from 100 to 500 days after the explosion. Two (2) people to survey 2-4 km per day in good weather. More difficult in rugged terrain, bedrock ubiquitous, or highly vegetated. Difficulties from geological complexities. E-field Telluric methods use currents induced in earth by ionospheric activity. Two-person team can use automated equipment over several kilometers per day. Multiple-frequency bands necessary from 0.05 to 125 Hz. Similar problems of interpretation to SP. [CTBT/OSI/WS-4/PR/21]

TEM might detect the buried cavity following an explosion. Detailed specifications are suggested for the equipment: (CTBT/OSI/WS-6/PR/9)

One objective is to directly detect cavity and rubble zone, heat flows, gaseous and fluid flows caused by an UNE. Consider two methods, Transient Electromagnetic method (TEM) and spontaneous potential method. The TEM system requires EM transmitter (0.1 Hz to ~100 kHz), motor generator (~3 kW), EM receiver (sensor, data storage and display), and data processing system. Complicated geography and geology, and EM disturbances from the external environment limit the methods. [CTBT/OSI/WS-6/PR/11]

SP methods are difficult to interpret and are not recommended.

Controlled source methods are superior to E-field telluric using natural sources.

Specifications:

Standard specifications for specific method. Equipment readily available from manufacturers for geophysical exploration.

Receiver for deeper targets: Multi-function receiver for acquisition of controlled-source and natural source EM data: microprocessor controlled, keyboard for input, graphics display, ethernet port, and Windows compatible.

1. 6 or more channels depending upon application.
2. Menu driven, sunlight readable LCD display, screen graphics of time-domain decay, and relevant plots, real-time and statistics display
3. Adaptable to many EM methods: resistivity, time/frequency domain, TEM, and MT.
4. Compatible with transmitter for remote operation and control
5. Frequency range: .01 to 8 kHz minimum, 16 bit sampling minimum and phase accuracy between

Electrical Conductivity Measurements [Protocol, Part II, paragraph 69g]	
<p>channels</p> <ol style="list-style-type: none"> 6. Mass storage for at least 2 days operation unattended. 7. Anti-alias, powerline notch (at least 50 and 60 Hz), telluric filtering, automatic SP buckout, gain setting, and calibration. 8. Rugged, portable, and environmentally sealed, -30 to +45 C minimum extremes, operable in direct rain. <p>Transmitter: Multi-purpose transmitter to accommodate either inductive loads (loops) or grounded dipoles. Utilize different power sources including battery, AC from generators or main power supply (50/60 Hz) with maximum power output of 3 kW and frequency range of DC to 10 kHz minimum depending upon power source. Can be operated for shallow transient EM or deep TEM, either time domain or frequency domain. Compatible with receiver for automatic acquisition.</p> <p>Receiver/Transmitter for shallow targets: Integrated transmitter and receiver unit designed for shallow induction measurements (20 m or less). Allows real-time analysis and display. Battery-powered and portable for one- or two-person operation. Instrument capable of 0.1% precision at full-scale over several ranges of conductivity (± 10, ± 100, ± 1000 milliseimen/meter) preferred.</p>	
<p>Procedures:</p> <p>See http://www.geophysics.co.uk/methods.html</p>	
<p>Examples of Manufacturers:</p> <p>Zonge, Phoenix Geophysics, Samtec, Geometrics, Scintrex.</p>	

APPENDIX A1

Basic Application Procedures for Geophysical Techniques (Contribution open for discussion)

Note: Here application procedures mean both those technical steps the IT should take for effective and efficient application of each of the geophysical techniques, and making the process of application transparent for the ISP and IT to follow and cooperate. For all geophysical techniques, there are some general procedural items in common, which are listed below. They could be further elaborated and finally considered as a part of contribution to 6.5.2. Search logic, procedures and criteria, (Section 6.5, Continuation Period of Inspection of Draft Initial Rolling Text of the Operational Manual). In the following sub-sections (6.5.3 to 6.5.6) concerning each individual geophysical technique, more detailed and technique-specific procedures could be define, within each of the following general procedural items as necessary.

General application procedures for geophysical techniques are to:

1. Design an initial working plan, including different tasks in the application, specific aims, and personnel responsibilities, etc. ;
2. Determine a limited area of application, based on all data collected;
3. Evaluate local geographical and geological conditions and collect necessary data for application of the technique and later interpretation of measured results, with possible assistance from the ISP;
4. Collect relevant environmental information on the possible external interference with measurement, e.g. mining activities, power lines, buildings and traffic, etc., with possible assistance from the ISP;
5. Prepare equipment and transport it to the survey area; update the working plan and specify termination conditions for each technology to be used;
6. Prepare an equipment deployment plan and implement it;
7. Test and select the most appropriate equipment parameters and working parameters, e.g. in TEM: frequencies, electric current intensity, loop size, location and spacing of EM transmitters and receivers, etc.;
8. Acquire data and assure data quality;
9. Process and analyze data;
10. Evaluate intrinsic measurement limitations and possible external measurement restrictions;
11. Interpret data;
12. Make decision for further applications or termination of activities, taking into account the synergy with other techniques.

APPENDIX B

Recommendation for Section 5.9 of Chapter 5 of the OSI Operational Manual (Size and Composition of Inspection Team)

Chapter 5 Inspection Preparation

Section 5.9 Size and Composition of Inspection Team

- 5.9.1. The size of the inspection team will be in accordance with paragraphs 9 and 10 of Section A of Part II of the Protocol.
- 5.9.2. The primary factor to be considered when the composition of the inspection team is determined is flexibility, as the team composition is scenario-dependent. When selecting the inspection team members, the Director-General, with the assistance of the Technical Secretariat, should develop the team composition necessary for the effective conduct of the inspection by considering, *inter alia*, the contents of the inspection request, the terrain and climate of the ISP, the anticipated ISP infrastructure support, the expertise required, the ratio of inspectors to inspection assistants, the maximum duration of the inspection, and the desirability of phasing and rotation (or substitution) of inspection team members.
- 5.9.3. In developing the inspection team composition, the following functional capabilities should be included:
 1. Deputy team leader(s)
 2. All mandated inspection activities (paragraph 69 of Section E of Part II of the Protocol to the CTBT)
 3. Calibration of inspection equipment
 4. Planning and scheduling
 5. Archiving of data and samples at the base of operations
 6. Transporting of data and samples
- 5.9.4. Selection priority should be given to individuals with multiple capabilities.
- 5.9.5. Every function represented on the inspection team should have minimum of one backup individual, either as an individual who possesses that function as a secondary function through cross-training or as an additional individual from the list of inspectors and inspection assistants having that function as a primary one.
- 5.9.6. In developing the team composition, the following assumptions are made:

1. A common working language (one of the six UN languages) should be used by the inspection team. It should be the same language as the one used by the TS for training.
2. The translation/interpretation service provided by the ISP shall be between the team working language and ISP language.
3. The reports and communications for the IT shall be in the team working language, and translation into the other UN languages will only be done at the CTBTO for those reports that are intended for use of the EC.
4. If the ISP is unable to provide this Treaty-mandated support, the ISP or the TS may contract such services under the auspices of the ISP. The staff required for such support shall not be counted toward the maximum limit of 40 inspection team members on the territory of the ISP.

Issues/Questions Requiring Further Discussion:

- The Protocol (in the inspection mandate – paragraph 42(g) of Section C of Part II) mentions only one inspection team leader (ITL); this could create a problem should the ITL become incapacitated or otherwise become unavailable. There must be some means of relieving an ITL. The same is true for the single observer mentioned in the inspection mandate. (COMMENT: Paragraph 61 of the Treaty permits up to three observers; is this an inconsistency between two Treaty/Protocol references that needs to be resolved?). Is the concept of a “temporary absence” or “break in physical presence” an acceptable concept?
- The TS should provide a liaison person with the ISP (e.g., at the POE, at the National Authority, or elsewhere as required) during an OSI. Such presence will enhance communications between the ISP National Authority and the CTBTO (CTBT Article III, paragraph 4) to expedite logistics support for the inspection team. This person should not be considered as a member of the inspection team and does not perform inspection activities specified in paragraph 69 of Section E of Part II of the Protocol.
- As a matter of efficiency and expediency, a core team of up to 20-25 (from the inspection team list and the TS) may go into the POE first, followed by the remainder of the team at a later date.
- In an effort to limit the number of individuals with logistical expertise on the inspection team, is it possible to have the TS contract such support through the ISP, if the ISP cannot directly provide such support? Either from the ISP or another State Party?
- What constitutes the need for a modification in the inspection mandate (i.e., to change IT members, etc.) if technically no decision is required to permit the OSI to enter the continuation period? Is this a legal question?
- Is it necessary that one of the qualifications of an inspection team member should be the ability to speak the common working language? If so, should this be a qualification that is specified in the OSI Operational Manual to assist the States Parties in designating their inspectors and inspection assistants? Or can the States

Parties nominate inspection team members, and request that the CTBTO provide a course in that language? If so, who pays?

APPENDIX C

Recommendation for Section 4.4 of Chapter 4 of the OSI Operational Manual (Standing Arrangements: Privileges and Immunities)

Chapter 4 Standing Arrangements for States Parties

Section 4.4 Privileges and Immunities

The privileges and immunities accorded to inspectors and inspection assistants will be in accordance with paragraphs 26 through 31 of Section B and paragraph 62 of Section E of Part II of the Protocol. In support of these privileges and immunities, the following is also to be considered:

- 4.4.1 The person of an individual inspection team member shall be inviolable and shall not be liable to any form of arrest or detention. The inspected State Party shall treat the inspection team member with due respect and shall take all appropriate steps to prevent any attack on his person, freedom or dignity.
- 4.4.2 The private temporary residence of inspection team members shall be inviolable and the members from the inspected State Party may not enter them, except with the consent of the inspection team leader. The inspected State Party is obligated to take all appropriate steps to protect this temporary residence against any intrusion or damage and to prevent any disturbance or impairment of its dignity. The temporary residence, its furnishings and other property thereon and the means of transport of the inspection team shall be immune from search, requisition, attachment or execution, for the entire period it is occupied by the inspection team.
- 4.4.3 Inspection team members shall enjoy immunity from the criminal jurisdiction and from the civil and administrative jurisdiction of the inspected State Party. They also are not obliged to give evidence as a witness, and are exempt from most legal actions, (except in certain limited cases). Nonetheless, inspection team members are required to respect local laws.
- 4.4.4 Inspection team members shall be exempt from all dues and taxes, personal or real, regional or municipal, except for the exemptions in Article 34 of the Vienna Convention. These are substantially as follows: indirect taxes normally incorporated into the prices of goods or services; real estate taxes and other fees related to property situated in the territory of the inspected State Party for purposes of the mission. Additionally, the living quarters and working spaces of the inspection team are exempt from national, regional or municipal dues and taxes.
- 4.4.5 Inspection team members shall be able to communicate with the TS and among team members concerning inspection strategies without the presence of the ISP. In addition,

inspection team members shall be allowed similarly to have personal communications with family members.

Issues/Questions Requiring Further Discussion:

- The extent of the ISP presence during all inspection team communications. What is the definition of an inspection activity as specified in paragraph 69 of Section E of Part II of the Protocol?
 5. For example, if, according to paragraph 4.4.2 in this Appendix, the living quarters of the IT are closed to the ISP, how does the ISP assure itself that no inspection activity (or another activity that has been agreed to be carried out in the presence of ISP personnel) is carried out inside the premises?
- Definition and procedures for personal communications of the inspection team members.

APPENDIX D

Recommendation for Deployment Option Considerations

Note: The following considerations could be included in the Operational Manual or a specific TS/OSI Division Standard Operating Procedures or Handbook.

ASSEMBLY OPTION CONSIDERATIONS

1. Time: This criterion is a prediction of the amount of time it could take for IT members to arrive at a designated location (Vienna, assembly area or POE) upon EC decision to conduct an OSI.
2. Costs: This criterion is an estimate of the cost of travel of the IT members to a designated location (Vienna, assembly area or POE). For all options, personnel travel costs are scenario dependent, based on locations of the inspected State Party's POE, the IT member's home country, and any intermediate destinations.
3. Operational Efficiency: This criterion addresses the effectiveness of an IT to conduct an OSI, taking into account the benefits of team-building, overall mission preparation, and familiarity with individual mission task assignments.
4. Operational Security: This criterion addresses the extent of operational security or safety provided to IT. Due to the possible hostility of the inspected State Party, it is important that the IT is able to protect its members, equipment, operations, and findings from adversarial influences or personnel. This is especially important in situations where attempts are made to discredit the team's findings.

Option 1: IT members are assembled in Vienna

CRITERIA	ADVANTAGES	DISADVANTAGES
TIME	This option would be the most timely if Vienna is located closest to the POE.	
COSTS		Travel costs for assembly of the IT is higher, since IT members must first come to Vienna, then deploy to the designated POE. Actual cost depends on the distance between the point of origin of the IT members and Vienna.
OPERATIONAL EFFICIENCY	Operational efficiency is best under this option. IT members have time to rest and attend team briefings. There is more	Travel to Vienna could reduce the operational efficiency of those inspectors whose home country is near the designated POE and have

	<p>opportunity for team-building and preparing for assigned inspection tasks, with personnel and materials available at the TS, particularly the IT Leader. Time for this activity could be increased if IT members are recalled as soon as possible after the inspection request is received, so that mission preparations also could occur up until the time of the final DG decision is made. It could also reduce the need for long-distance coordination with team members.</p> <p>Only one notification to the ISP would be needed if all IT members arrives at same time</p>	to travel long distances to Vienna, only to then travel to the designated POE
OPERATIONAL SECURITY	Operational security is best under this option. All materials used by the TS in preparing for the inspection are readily available in Vienna. There is no increased risk to individual IT members, since the IT is in a "safe" environment and will travel as a unit to inspected State Party's POE.	

Option 2: IT members are assembled at the POE

<u>CRITERIA</u>	<u>ADVANTAGES</u>	<u>DISADVANTAGES</u>
TIME	The swiftest option for travel of IT members from their home countries to the inspected State Party's POE (within 24 or 48 hours of recall), if there is no restriction on arrival at the designated POE, i.e., phasing.	The IT and the ISP would have to prepare to deal with multiple arrivals (with possible delays) that could potentially impact the mission. IT also complicates the definition of arrival times that could affect Treaty timelines.
COSTS	The least expensive option for	

	travel costs of IT members, since it involves a direct flight from home country to POE.	
OPERATIONAL EFFICIENCY	Operational efficiency of inspection team is lowest. Team-building and joint mission preparation/planning with the benefit of materials and IT members available at the TS is lost.	Possible multiple notifications to the ISP that reflect the individual arrival times may be necessary.
OPERATIONAL SECURITY		Operational security is lowest of the four options, since the safety of the IT members is at a higher risk if arriving individually at the ISP's designated POE, especially if in a potentially hostile environment. It could subject IT members to harassment or harm.

Option 3: IT members are assembled at a regional assembly area

CRITERION	ADVANTAGES	DISADVANTAGES
TIME	This option could be one of the fastest for travel since it uses a regional assembly area that should be closer to the ISP's designated POE than Vienna. This is most beneficial for IT members from the vicinity of the regional assembly area.	
COSTS		Travel costs for inspection team may be higher, since ALL inspectors would travel to an intermediary location before traveling together to the POE; perhaps some of them from a longer distance. In addition, logistical and administrative standing arrangements with a hosting State Party are required to ensure availability of adequate facilities for transit of the IT and equipment, as well as an advance planning team. This may involve

		additional costs to ensure short-notice availability.
OPERATIONAL EFFICIENCY	<p>Only one formal notification is required, in accordance with paragraph 43(b) of Section of Part II of the Protocol, since the IT members will arrive as a unit at the designated POE.</p> <p>Operation efficiency should also be similar to Option 1, if the entire IT is formed early enough to rest and jointly prepare for the inspection mission.</p>	Some inspectors may have to fly a long distance and may not have adequate time to rest and prepare for inspection. Since the regional assembly area is a temporary location, it may not have available all the background materials that may be necessary to prepare for the mission
OPERATIONAL SECURITY	Operational security is assumed to be similar to Option 1 with regard to safety of the IT and availability of secure TS-controlled facilities and communications to prepare the mission. There may be variations on what materials are available at each regional assembly area, but if the IT has equal access to all materials available in Vienna, then all aspects of operational security should be similar to Option 1.	

APPENDIX E

Recommendation for Section 5.10 of Chapter 5 of the OSI Operational Manual (Selection, Call-up and Assembling of Inspection Team Members)

CHAPTER 5 Inspection Preparation

SECTION 5.10 Selection, Call-Up and Assembling of Inspection Team Members

Selection, call-up and assembly of the inspection team from the list of inspectors and inspection assistants who are located around the world require the use of an innovative communication system. Such a system should facilitate this process and the team's deployment to a POE in the most economical and efficient manner to meet the timelines specified in the Treaty/Protocol. This task will require procedures whose execution may include the selection of one option, or a combination of options, based on the mission analysis performed by the TS during the preparatory phase of an on-site inspection. This analysis will take into account the advantages and disadvantages for each option.

5.10.1 Selection of the inspection team members. The DG, with the support of the TS/OSI Division, will select inspection team members in accordance with the criteria and guidelines specified in Section 5.9 of this Chapter.

5.10.2 Call-up of inspection team members. [Comment: The PTS has yet to develop a communication system for this purpose; once completed, the procedures for this call-up will be included in this section or in the OSC section.]

5.10.3 Assembly of inspection team members. Logically, the TS will have at its disposal several options from which it can choose or, if the situation dictates, combine for the cost-effective, timely and efficient assembly of the inspection team. These options may include, but are not limited to, the following:

1. Inspection team members assemble in Vienna where they are equipped and briefed, and then deploy as a group to the designated POE;
2. Inspection team members assemble at the designated POE and are then equipped and briefed, either at the POE or after arriving at the inspection area) and/or
3. Inspection team members assemble at a pre-identified regional location or assembly point, equipped and briefed, and then deploy to the designated POE.
4. The inspection team assembly process will directly impact the logistical preparations of the TS. During this period, myriad activities are occurring in preparation for the inspection. These activities will include, *inter alia*, communication with other States Parties, equipment preparations, transportation coordination, inspection team selection and notifications, movement of critical inspection team members, and inspection plan development. The timeframe in which a team is assembled, prepared, and deployed is very limited and success will depend on the TS's ability to develop a streamlined process to manage the pre-inspection period activities.

5. *Depending on the location of the assembly point, inspection team members may require a visa to meet at that assembly point, as well as a visa to proceed to the POE. Visa transfers should also be considered.*
6. Each of the options has associated advantages and disadvantages that the TS will consider in its mission analysis for the conduct of the on-site inspection.

Issues/Questions Requiring Further Discussion:

- The desirability of a regional assembly point.
- Addition of a definition of assembly point in the glossary of the OSI Operational Manual (see Appendix R).
- Does the inspection process cease if any of the inspection timelines are not met?

APPENDIX F

Recommendation for Section 4.3 of Chapter 4 of the OSI Operational Manual (Standing Arrangements: POE Arrangements)

Chapter 4 Standing Arrangements for States Parties

Section 4.3 POE Arrangements

The States Parties will designate points of entry (POEs) in accordance with paragraphs 32 through 34 of Section B of Part II of the Protocol. In addition to these provisions for the designation of a POE, a State Party should also consider the following:

- 4.3.1. At the POE, it is expected that the ISP will facilitate the arrival of inspection team members at the POE, and the follow-on movement of the team to the inspection area.
- 4.3.2. The location and facilities at the POE will impact the logistical coordination and the expenditure of both ISP and inspection team resources (time and manpower).
- 4.3.3. The POE facilities should contain adequate warehouses, lodging, and meeting or conference facilities, either at or near the POE, in order to support the arrival of the inspection team (food and lodging) and its equipment during the transit through the POE en route to the inspection area.
- 4.3.4. The POE facilities should have the capability of supporting both domestic and international transport requirements by air, sea or ground transportation, to include the use of non-scheduled aircraft, if needed.
- 4.3.5. States Parties may designate more than one POE.
- 4.3.6. States Parties will designate or change POEs using the notification format located in appendices H-J.

Issues/Questions Requiring Further Discussion:

- Addition of a definition of “POE” (the area that the POE encompasses) in the glossary of the OSI Operational Manual (see Appendix R);
- Can one POE be used for inspection team members and a different one for equipment?

APPENDIX G

Recommendation for Section 4.5 of Chapter 4 of the OSI Operational Manual (Standing Arrangements: Use of Non-Scheduled Aircraft)

Chapter 4 Standing Arrangements for States Parties

Section 4.5 Use of Non-Scheduled Aircraft

The use of non-scheduled aircraft by the inspection team for the conduct of an OSI will be in accordance with paragraph 35 of Section B, and paragraphs 46 and 47 of Section D, of Part II of the Protocol. In addition to these provisions for use of non-scheduled aircraft, a State Party should also consider the following:

- 4.5.1. Use of non-scheduled aircraft when timely commercial transport for inspections is not available or feasible, when commercial transportation is not reliable, or when commercial transportation is not scheduled at appropriate times or is unavailable for other reasons.
- 4.5.2. Non-scheduled aircraft are not required to be owned by a particular state or entity (such as the Technical Secretariat), and there is no requirement to use any particular type of non-scheduled aircraft (e.g., a helicopter could be used).
- 4.5.3. Non-scheduled aircraft used by the inspection team for its transportation to the POE may be also used to facilitate the timely movement of the inspection team to a basing point near, or within, the inspection area.
- 4.5.4. States Parties will notify the TS of designated aircraft routings to the POE and the standing diplomatic clearance numbers using the notification formats located at Appendices K-N and O-P, respectively.
- 4.5.5. The TS will notify States Parties of its acceptability and/or non-acceptability of the non-scheduled aircraft routings using the notification format located at Appendix N.

Issues/Questions Requiring Further Discussion:

- Addition of a definition of “non-scheduled aircraft” to the glossary of the OSI Operational Manual (see Appendix R).
- Addition of a definition of “basing point” to the glossary of the OSI Operational Manual (see Appendix R).

APPENDIX H

Recommendation for Notification Format for Annex 5 (Notification by a State Party of Designated or Change of Designated Point(s) of Entry)

SUBJECT: Notification by a State Party of Designated, or Change of Designated, Point(s) of
Entry

Designated Point of Entry Number 1

1. Name
2. Address
3. Location (latitude/longitude optional)
4. Type of POE (airport, seaport, rail/road)
5. Name of airport, etc. (optional)
6. Effective date
7. Remarks (availability of storage/warehouses, aircraft-offloading equipment, etc.)

Designated Point of Entry Number 2 (if available)

5. Name
6. Address
7. Location (latitude/longitude optional)
8. Type of POE (airport, seaport, rail/road)
9. Name of airport, etc. (optional)Effective date
10. Remarks (availability of storage/warehouses, aircraft-offloading equipment, etc.)

Designated Point of Entry Number 3 (if available)

1. Name
2. Address
3. Location (latitude/longitude optional)
4. Type of POE (airport, seaport, rail/road)
5. Name of airport, etc. (optional)
6. Effective date
7. Remarks (availability of storage/warehouses, aircraft-offloading equipment, etc.)

Designated Point of Entry Number 4 (if available)

1. Name
2. Address

3. Location (latitude/longitude optional)
4. Type of POE (airport, seaport, rail/road)
5. Name of airport, etc.(optional)
6. Effective date
7. Remarks (availability of storage/warehouses, aircraft-offloading equipment, etc.)

Issues/Questions Requiring Further Discussion:

- Is it necessary for the inspection team to use the same point of entry as for the inspection equipment? Can multiple points of entry be included in the inspection mandate?
- Produce a format for notification to all the States Parties by the TS of all the designated points of entry.

APPENDIX I

Recommendation for Notification Format for Annex 5 (Technical Secretariat Notification to States Parties of All Designated Point(s) of Entry)

SUBJECT: TECHNICAL SECRETARIAT NOTIFICATION TO STATES PARTIES OF
ALL DESIGNATED POINT(S) OF ENTRY

1. OSI/CTB MESSAGE NUMBER: Year-Sequential Message Number/Format Number
(Example: 2001-01/33)
2. REFERENCE:
3. CONTENT:

IN ACCORDANCE WITH PARAGRAPH 32 OF SECTION B OF PART II OF THE
PROTOCOL, THE TECHNICAL SECRETARIAT NOTIFIES ALL STATES PARTIES OF
ALL DESIGNATED POINT(S) OF ENTRY AND/OR RELATED DATA.

United States: Point of Entry Number 1		Location		Type			Airport Code	Effective Date
Name	Address	Lat	Long	Air	Sea	Rail		
Dulles	45045 Aviation Dr., Dulles VA	40 06 N	110 10 W	X			IAD	01 Aug xx

United States: Point of Entry Number 2		Location		Type			Airport Code	Effective Date
Name	Address	Lat	Long	Air	Sea	Rail		
San Francisco				X			SFA	07 Sep xx

State Party #2: Point of Entry Number 1		Location		Type			Airport Code	Effective Date
Name	Address	Lat	Long	Air	Sea	Rail		

(Etc.)

4. REMARKS:

5. END OF OSI/CTB MESSAGE NUMBER: Year-Sequential Message Number/Format
Number
(Example: 2001-01/33)

APPENDIX J

Recommendation for Notification Format for Annex 5 (Technical Secretariat Notification to States Parties of Changes to All Designated Point(s) of Entry)

SUBJECT: TECHNICAL SECRETARIAT NOTIFICATION TO STATES PARTIES OF
CHANGES TO DESIGNATED POINT(S) OF ENTRY

5. OSI/CTB MESSAGE NUMBER: Year-Sequential Message Number/Format Number
(Example: 2001-01/33)

6. REFERENCE:

7. CONTENT:

IN ACCORDANCE WITH PARAGRAPH 33 OF SECTION B OF PART II OF THE
PROTOCOL, THE TECHNICAL SECRETARIAT NOTIFIES ALL STATES PARTIES OF
CHANGES TO DESIGNATED POINT(S) OF ENTRY AND/OR RELATED DATA.

United States: Point of Entry Number 1		Location		Type			Airport Code	Effective Date
Name	Address	Lat	Long	Air	Sea	Rail		
Dulles	45045 Aviation Dr., Dulles VA	40 06 N	110 10 W	X			IAD	01 Aug xx

United States: Point of Entry Number 2		Location		Type			Airport Code	Effective Date
Name	Address	Lat	Long	Air	Sea	Rail		
San Francisco				X			SFA	07 Sep xx

State Party #2: Point of Entry Number 1		Location		Type			Airport Code	Effective Date
Name	Address	Lat	Long	Air	Sea	Rail		

(Etc.)

(Note: It is recommended that the TS should only address the State Party (or States Parties) who has (have) notified the TS of a POE change, but should notify States of all designated POEs. In this manner it can serve as a confirmation to National Authorities of the completeness of the POE data listed in the TS database.)

4. REMARKS:

5. END OF OSI/CTB MESSAGE NUMBER: Year-Sequential Message Number/Format
Number
(Example: 2001-01/33)

APPENDIX K

Recommendation for Notification Format for Annex 5 (Initial Notification of Non-scheduled Aircraft Routings by a State Party to the TS)

SUBJECT: INITIAL NOTIFICATION OF NON-SCHEDULED AIRCRAFT ROUTINGS

1. OSI/CTB MESSAGE NUMBER: Year-Sequential Message Number/Format Number
(Example: 2001-01/33)

2. REFERENCE:

3. CONTENT:

THIS IS THE INITIAL NOTIFICATION OF AIRCRAFT ROUTINGS THAT
ARE TO BE USED FOR THE REMAINDER OF CALENDAR YEAR FOLLOWING
ENTRY INTO FORCE.

A. AIRCRAFT ROUTINGS TO THE TERRITORY OF:

1. POINT OF ENTRY [Name of POE]: [Flight Route]
2. [etc.]

B. AIRCRAFT ROUTINGS FROM THE TERRITORY OF:

1. POINT OF ENTRY [Name of POE]: [Flight Route]
2. [etc.]

4. REMARKS:

5. END OF OSI/CTB MESSAGE NUMBER: Year-Sequential Message Number/Format
Number
(Example: 2001-01/33)

APPENDIX L

Recommendation for Notification Format for Annex 5 (Annual Notification of Non-scheduled Aircraft Routings by a State Party to the TS)

SUBJECT: ANNUAL NOTIFICATION OF NON-SCHEDULED AIRCRAFT ROUTINGS

1. OSI/CTB MESSAGE NUMBER: Year-Sequential Message Number/Format Number
(Example: 2001-01/34)
2. REFERENCE:
3. CONTENT:

THIS IS THE ANNUAL NOTIFICATION OF AIRCRAFT ROUTINGS THAT
HAVE BEEN AGREED AS OF MM/DD OF CALENDAR YEAR [Year].

A. AIRCRAFT ROUTINGS TO THE TERRITORY OF:

1. POINT OF ENTRY [Name of POE]: [Flight Route]
2. [etc.]

B. AIRCRAFT ROUTINGS FROM THE TERRITORY OF:

1. POINT OF ENTRY [Name of POE]: [Flight Route]
2. [etc.]

4. REMARKS:
5. END OF OSI/CTB MESSAGE NUMBER: Year-Sequential Message Number/Format
Number (Example: 2001-01/33)

APPENDIX M

Recommendation for Notification Format for Annex 5 (Notification of Changes/Additions to Non-scheduled Aircraft Routings by a State Party to the TS)

SUBJECT: NOTIFICATION OF CHANGES/ADDITIONS TO NON-SCHEDULED AIRCRAFT ROUTINGS

1. OSI/CTB MESSAGE NUMBER: Year-Sequential Message Number/Format Number
(Example: 2001-01/35)

2. REFERENCE:

3. CONTENT:

A. CHANGED AIRCRAFT ROUTINGS TO THE TERRITORY OF [COUNTRY]: [Yes/No].
[If yes, include the following data on each POE:]
EFFECTIVE ON [Date].

1. POINT OF ENTRY [Name of POE]: [Flight Route]
2. [etc.]

B. CHANGED AIRCRAFT ROUTINGS FROM THE TERRITORY OF [COUNTRY]:
[Yes/No]. [If yes, include the following data on POE:]
EFFECTIVE ON [Date].

1. POINT OF ENTRY [Name of POE]: [Flight Route]
2. [etc.]

C. ADDITIONAL AIRCRAFT ROUTINGS TO THE TERRITORY OF [COUNTRY]: [Yes/No].
[If yes, include the following data on POE:]
EFFECTIVE ON [Date].

1. POINT OF ENTRY [Name of POE]: [Flight Route]
2. [etc.]

D. ADDITIONAL AIRCRAFT ROUTINGS FROM THE TERRITORY OF [COUNTRY]:
[Yes/No]. [If yes, include the following data on POE:]
EFFECTIVE ON [Date].

1. POINT OF ENTRY [Name of POE]: [Flight Route]
2. [etc.]

4. REMARKS:

5. END OF OSI/CTB MESSAGE NUMBER: Year-Sequential Message Number/Format
Number (Example: 2001-01/35)

APPENDIX N

Recommendation for Notification Format for Annex 5 (Notification of Acceptability/Unacceptability of Non-scheduled Aircraft Routings by the TS)

SUBJECT: NOTIFICATION OF ACCEPTABILITY/UNACCEPTABILITY OF NON-SCHEDULED AIRCRAFT ROUTINGS

1. OSI/CTB MESSAGE NUMBER: Year-Sequential Message Number/Format Number
(Example: 2001-01/36)

2. REFERENCE:

3. CONTENT:

A. THIS NOTIFICATION INDICATES ACCEPTABILITY OF THE FOLLOWING AIRCRAFT ROUTING(S) AS NOTIFIED IN OSI/CTB MESSAGE NUMBER [yy-nnn]: [Yes/No].

1. AIRCRAFT ROUTINGS TO THE TERRITORY OF [COUNTRY]:

I. POINT OF ENTRY [Name of POE]: [Flight Route]

II. [etc.]

2. AIRCRAFT ROUTINGS FROM THE TERRITORY OF [COUNTRY]:

I. POINT OF ENTRY [Name of POE]: [Flight Route]

II. [etc.]

B. THIS NOTIFICATION INDICATES UNACCEPTABILITY OF THE FOLLOWING AIRCRAFT ROUTING(S) OF FLIGHT AS NOTIFIED IN OSI/CTB MESSAGE NUMBER [yy-nnn]: [Yes/No]

1. AIRCRAFT ROUTINGS TO THE TERRITORY OF [COUNTRY]:

I. POINT OF ENTRY [Name of POE]: [Flight Route]

II. [etc.]

2. AIRCRAFT ROUTINGS FROM THE TERRITORY OF [COUNTRY]:

I. POINT OF ENTRY [Name of POE]: [Flight Route]

II. [etc.]

4. REMARKS:

5. END OF OSI/CTB MESSAGE NUMBER: Year-Sequential Message Number/Format
Number (Example: 2001-01/36)

APPENDIX O

Recommendation for Notification Format for Annex 5 (Initial Notification of Standing Diplomatic Clearance Numbers for Use by Non-scheduled Aircraft)

SUBJECT: INITIAL NOTIFICATION OF STANDING DIPLOMATIC CLEARANCE
NUMBERS FOR USE BY NON-SCHEDULED AIRCRAFT

1. OSI/CTB MESSAGE NUMBER: Year-Sequential Message Number/Format Number
(Example: 2001-01/37)
2. REFERENCE:
3. CONTENT:

THIS IS THE INITIAL NOTIFICATION OF THE STANDING DIPLOMATIC
CLEARANCE NUMBER(S) THAT ARE TO BE USED FOR THE REMAINDER
OF CALENDAR YEAR [Year], FOR THE COMPREHENSIVE NUCLEAR TEST-BAN
TREATY ORGANIZATION'S TECHNICAL SECRETARIAT NON-SCHEDULED
AIRCRAFT FLIGHTS TO: [COUNTRY]

STANDING DIPLOMATIC CLEARANCE NUMBER: CTBT-XXXX-[Calendar Year]

4. REMARKS:
5. END OF OSI/CTB MESSAGE NUMBER: Year-Sequential Message Number/Format
Number (Example: 2001-01/37)

APPENDIX P

Recommendation for Notification Format for Annex 5 (Annual Notification of Standing Diplomatic Clearance Numbers for Use by Non-scheduled Aircraft)

SUBJECT: ANNUAL NOTIFICATION OF STANDING DIPLOMATIC CLEARANCE
NUMBERS FOR USE BY NON-SCHEDULED AIRCRAFT

1. OSI/CTB MESSAGE NUMBER: Year-Sequential Message Number/Format Number
(Example: 2001-01/38)
2. REFERENCE:
3. CONTENT:

THIS IS THE ANNUAL NOTIFICATION OF THE STANDING DIPLOMATIC
CLEARANCE NUMBER (S) THAT ARE TO BE USED BEGINNING ON MM/DD OF
CALENDAR YEAR [Year], FOR THE COMPREHENSIVE NUCLEAR TEST-BAN
TREATY ORGANIZATION'S TECHNICAL SECRETARIAT NON-SCHEDULED
AIRCRAFT FLIGHTS TO: [COUNTRY]

STANDING DIPLOMATIC CLEARANCE NUMBER: CTBT-XXXX-[Calendar Year]

4. REMARKS:
5. END OF OSI/CTB MESSAGE NUMBER: Year-Sequential Message Number/Format
Number (Example: 2001-01/38)

APPENDIX Q

Recommendation for Section 6.3.2 of Chapter 6 of the OSI Operational Manual (Procedures for Establishing the Base of Operations)

Chapter 6 Inspections for Underground Event Within the Territory of a State Party

Note: The workshop participants further discussed the requirements for the establishment of the base of operations and developed an annotated outline. This outline, based on the Chinese presentation at this workshop and the United States presentation at OSI Workshop-3, could be used as a resource document that contributes to the development of the OSI Operational Manual.

Section 6.3.2 Procedures for Establishing the Base of Operations

6.3.2.1 The following are basic guidelines to be used in selecting the location of the base of operations

1. Safety
2. Convenient for transportation
3. Locations with available buildings and facilities are preferred
4. The base of operations should be established within the IA or in its vicinity, preferably within the IA.
5. The base of operations should include two parts-----working area and lodging area.

Usually, two areas should not be far away from each other.

6.3.2.2. Procedures for determination and confirmation of the location of the base of operations

1. At the POE briefing, the ISP may propose a list of possible location(s) for the base of operations.
2. Based on the introduction of the ISP and the information obtained from the TS, the IT should consult with the representative of the ISP for the determination of locating the base of operations taking into account the basic guidance in selecting the location.
3. On arriving at the base, with assistance of the ISP, the IT should use the approved location-finding equipment (which can be provided by ISP) to confirm that the team is situated at the agreed location of the base of operations.

4. Throughout the OSI, any change of the location of the base of operations should be consulted and agreed between the IT and ISP.

6.3.2.3. Basic components of the Base of Operations

The infrastructure and facilities at the base should be provided or established according to the consultation between the PTS/IT and the ISP during the pre-inspection period or at the POE, fully taking into account of the local conditions. The basic infrastructure and facilities at the base should be depended on the activities to be conducted within the IA, generally following components should be included:

In the working area:

- Meeting rooms and offices
 - A. A conference room for the whole team meeting, consultation, briefing,.....
 - B. Conference rooms for sub-team meeting, urgent consultation.....
 - C. Rooms for the IT leader and the administrative staff
 - D. Communication office
- Workplaces and Laboratories
 - A. Data Offices: visual data office, overflight information office, seismic data office, geophysical data office (a appropriate number of data offices will be established according to the geophysical methods to be used).
 - B. Radionuclide Laboratories: sample handling lab, radionuclide measurement lab
 - C. Technical Support Offices: charge, equipment calibration and maintenance.....
- Storage Area
 - A. Filing cabinets:
 - B. Sample storage area:
 - C. Equipment storage area:
- Bath and Decontamination Tent
 - A. Bath
 - B. Decontamination tent
- Medical Services
 - A. Emergency medical service (e.g. ambulance, etc.)
 - B. Full-time medical services
 - Parking place

- Power source

In the living area:

- Lodging/accommodation for a minimum of 40 IT members and at most 3 observers
- Dining facilities
- Sanitary facilities
- Clinic

6.3.2.4 Basic Steps to Establish the Base of Operations

1. Before the IT arrives, the ISP should make preparations
2. On arriving at the base, to confirm the location.
3. To log down the arrival time and sign.
4. To check the radiation level at once.
5. To confirm that the agreed facilities are available.
6. To confirm the security arrangements
7. To Confirm the communication arrangements.
8. Any other issues .

6.3.2.5 Safety guarantee

1. The radiation monitoring at the base of operations
 - A. purpose: safety
 - B. methods: gamma total dose measurement, personnel health monitoring, ..., agreed between the IT and the ISP
 - C. equipment: handheld gamma spectrometer, ...
 - D. log
2. Contamination control
3. Urgent arrangement: for a new base because of safety

6.3.2.6 Activities at the base of operations

6.3.2.7 Communication arrangements and coordination between the IT and the ISP

1. Communication equipment (to include a facility for antennae)

2. Codes of communication
3. Conduct of the communication

6.3.2.8 Routing support and services from the ISP

Issues/Question Requiring Further Discussion:

- The number of times that a base of operations may be established.
- The distinction, if any, of radiation monitoring procedures and equipment, if the base of operations is located within or outside of the boundaries of the inspection area.

APPENDIX R

Proposed Definitions for OSI Operational Manual Glossary

Standing Arrangements: Standing arrangements are basically obligations or commitments that are in effect, or in place, prior to the conduct of an OSI. They are intended to facilitate, or assist in, the conduct of inspection activities and the provisions of amenities.

There are four categories of standing arrangements:

- 1) The legal obligations that are specified in paragraphs 14-40 of Section B of Part-II of the Protocol (required soon after EIF) and need no separate binding legal instrument between the CTBTO and States Parties.
- 2) The arrangements having no legal status that are agreed upon between the CTBTO and States Parties to provide assistance, logistical support, or amenities to the inspection team (after receipt of OSI request).
- 3) The arrangements having legal status that are agreed upon between the CTBTO and private contractors to provide assistance, logistical support, or amenities to the inspection team (both after EIF and/or after receipt of OSI request).
- 4) Any agreements or arrangements concerning other identified topics that the States Parties agree should be in place or “standing” prior to the conduct of an OSI.

Point(s) of Entry: The location designated by a State Party in accordance with paragraphs 32-34 of Section B of Part II of the Protocol for entry of the inspection team and its equipment. Such a location may be an airport, seaport, rail/road border crossing, or other designated facility. It also includes, as determined by the inspected State Party, an area in near proximity of this facility at which such activities as pre-inspection briefings can be conducted and equipment checked and stored.

Communication Methods: Communications between the inspection team and any other entity can be conducted using the telephone, facsimile, and/or e-mail systems.

Code for Communications: For communications security purposes, a system of communication in which arbitrary groups of letters, numbers, or symbols represent units of plain text of varying length.

Cipher: Any cryptographic system in which arbitrary symbols, or groups of symbols, represent units of plain units of plain text, or in which units of plain text are rearranged, or both.

Logistics Support: Any activity that assists in the support of the inspection team, such as transportation between to the POE, between the POE and the inspection area, and within the inspection area; meals, lodging, security and safety support, and other amenities, as required.

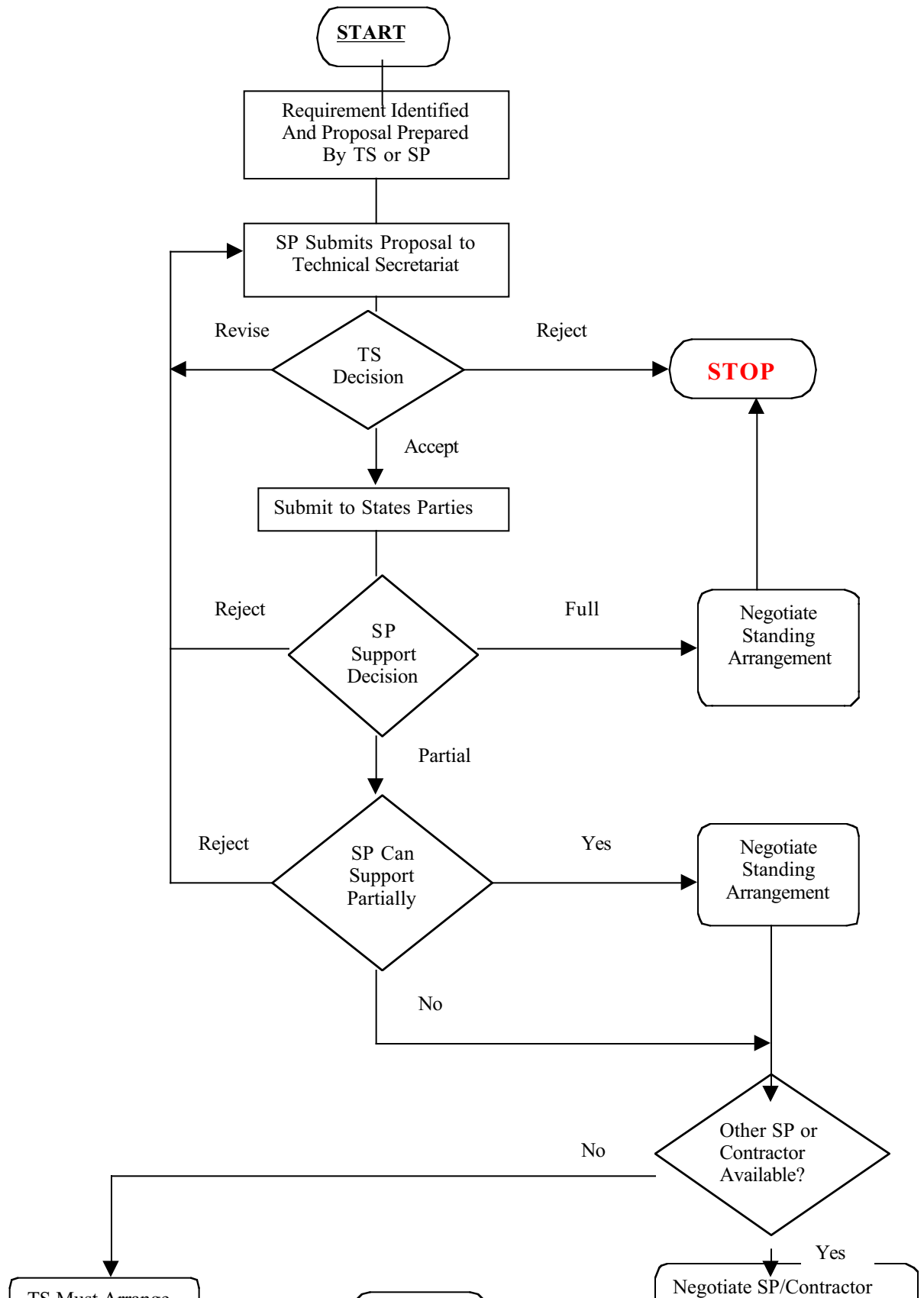
Assembly Point: A temporarily staffed facility, chosen during inspection preparations from a prearranged list. This facility would be located strategically in a Host State Party, at a major air-traffic hub, to facilitate IT assembly before departure to the designated POE. Such an approach would require the TS to obtain the assistance of the Host State Party to coordinate the accommodations and work spaces, if required, of the IT while in transit as well as to conduct preparation activities. A standing arrangement with the Host State Party is necessary to facilitate this option.

Non-Scheduled Aircraft: Any aircraft (military, commercial charter) that does not fly according to a published international flight schedule.

Basing Point: An intermediary transit point within the ISP territory where the inspection team members and inspection equipment may be located temporarily during transportation between the POE and the inspection area. This point may be an airfield to accommodate a non-scheduled aircraft, as agreed by the inspection team leader and a representative of the ISP. It may be located near or within the boundaries of the inspection area.

APPENDIX S

Indicative Flow Chart for Preparation of Logistical and Administrative Standing Arrangements



Appendix T

Recommendation for Illustrative Templates for Possible Logistical/Administrative Standing Arrangements with States Parties

Illustrative Template 1:

2.1 Inspection Equipment Supplied by State Parties

2.1.1 Introduction

2.1.1.1 *This Standing Arrangement is proposed by:* Technical Secretariat

2.1.1.2 *This Standing Arrangement covers* all equipment, materials, services, and support required by an IT during the course of an OSI in Country X.

2.1.1.3 *This Standing Arrangement shall become effective* [90 days after EIF] and shall remain effective for a period of [five (5)] years unless renegotiated prior to that date.

2.1.1.4 Benefits

2.1.1.4.1 Equipment provided to the IT by the ISP is to be safety tested and approved for use in the local environment.

2.1.1.4.2 The TS will expend less money by reimbursing the ISP for these products and services than by purchasing, maintaining, and transporting them to and from the Inspection Area.

2.1.1.4.3 The ISP will be able to pre-position the required support in the IA as soon as it receives notification of an OSI. This will save significant amounts of time compared to transporting the required support from the TS warehouse to the POE and then to the IA.

2.1.1.4.4 Overall efficiency is improved by having the ISP provide the IT support from its local resources.

2.1.1.5 Assumptions

2.1.1.5.1 The Technical Secretariat will possess the specialized scientific equipment needed by the IT to perform an inspection and will transport such equipment to the designated POE.

2.1.1.5.2 When an inspection is approved, the ISP will provide all necessary support to the IT, as described in the Treaty and its Protocols.

2.1.1.5.3 If the ISP cannot provide the necessary support, the TS will attempt to obtain the support from another State Party, or from a private contractor.

- 2.1.1.5.4 If no State Party or private contractor is willing to provide the support or if the ISP will not permit the outside State Party or private contractor support, the TS must make arrangements to support the IT with its own resources.
- 2.1.1.5.5 Each State Party has set up a National Authority to handle OSI matters and has provided the contact information to the TS as required by the Treaty.

2.1.2 Roles and Responsibilities of an ISP

- 2.1.2.1 *Note:* POE arrangements are covered by another Standing Arrangement. Reference Chapter IV, Section 4.2 POE Arrangements

2.1.2.2 Transportation of IT and Inspection Equipment

- 2.1.2.2.1 POE to base of operations and return
- 2.1.2.2.2 Base of operations to inspection area
- 2.1.2.2.3 Inside inspection area
- 2.1.2.2.4 Emergency movements i.e. natural disaster, etc.

2.1.2.3 Communication

- 2.1.2.3.1 *Note:* Not all suggested forms of communication are mandated by the Treaty. Efficient communications will be a major factor in the success or failure of an OSI. For that reason, the ISP may wish to provide communications capability in excess of minimum requirements. Items noted with an * are beyond the Treaty minimums.

2.1.2.3.2 Base of Operations

- 2.1.2.3.2.1 Telephone link to Technical Secretariat
- 2.1.2.3.2.1 Digital data link to Technical Secretariat *
- 2.1.2.3.2.2 Email service *
- 2.1.2.3.2.3 Local phone service
- 2.1.2.3.2.4 Local pager service (alpha-numeric) *
- 2.1.2.3.2.5 Two-way radio service within the inspection area and while travelling between the base of operations and the inspection area if the base of operations is outside the inspection area.

2.1.2.3.3 Mobile in Inspection Area

- 2.1.2.3.3.1 Two-way radio to base camp
- 2.1.2.3.3.2 Radio data links from mobile test equipment to base camp *
- 2.1.2.3.3.3 Cell phone service *
- 2.1.2.3.3.4 Pager service *

2.1.2.3.4 Fuel

2.1.2.3.4.1 Gasoline

2.1.2.3.4.2 Diesel

2.1.2.3.4.3 Aircraft grade

2.1.2.3.5 Electric Power

2.1.2.3.5.1 Utility power

2.1.2.3.5.2 Regulated instrument power

2.1.2.3.5.3 Portable generators for field use

2.1.2.3.5.4 Batteries and charging equipment

2.1.2.3.6 Medical Support

2.1.2.3.6.1 Emergency medical evacuation

2.1.2.3.6.2 Emergency medical services and supplies

2.1.2.3.6.3 Routine medical services and supplies

2.1.2.3.6.4 First-aid services and supplies

2.1.2.3.7 Weather Forecasting

2.1.2.3.7.1 Short range: 1-5 days

2.1.2.3.7.2 Long range: 30-60 days

2.1.2.3.8 Warehousing/Equipment Handling

2.1.2.3.8.1 Base of operations

2.1.2.3.8.2 Inspection area

2.1.2.3.9 Overflight Support

2.1.2.3.9.1 Suitable aircraft as described in the Treaty and its Protocol

2.1.2.3.9.2 Suitable airfield for the overflight aircraft within appropriate distance of the base of operations and inspection area

2.1.2.3.9.3 Support services for the overflight aircraft

2.1.2.3.10 Field Repair/Fabrication Capability

2.1.2.3.10.1 Vehicle repair

2.1.2.3.10.2 Electronics repair/calibration

2.1.2.3.10.3 Communication equipment repair and service

2.1.2.3.10.4 Mechanical repair

2.1.2.3.10.5 Welding and fabrication

2.1.2.3.10.6 Machine shop services

2.1.3 Roles and Responsibilities of the DG and TS

- 2.1.3.1 Provide a comprehensive list of inspection equipment the TS will send with the IT.
- 2.1.3.2 Provide a list of inspectors and any special requirements they may have.
- 2.1.3.3 Notify the ISP when the IT will arrive at the POE.
- 2.1.3.4 Notify the ISP if any non-scheduled aircraft will be used.

2.1.4 Coordination Procedures

- 2.1.4.1 TS shall establish regular communication schedules with SP
- 2.1.4.2 TS and SP shall exchange questions and answers on both regular and ad hoc schedules.

Illustrative Template 2

This Standing Arrangement is proposed by: The Technical Secretariat

The scope of this Standing Arrangement shall encompass all official CTBT-related communications between the TS and SP and between SP.

The Standing Arrangement shall be effective on entry into force for each State Party and shall continue for the duration of the Treaty unless renegotiated.

All parties will benefit from effective, reliable intercommunication as a result of establishing this Standing Arrangement.

A2.1 Liaison Procedures: Technical Secretariat with State Party National Authorities

2.1.1 Roles and Responsibilities of States Parties:

- 2.1.1.1 Each State Party shall set up or designate a National Authority and shall so inform the Organization upon entry into force of the Treaty for that State Party. The National Authority shall serve as the national focal point for liaison with the Organization and with other States Parties.
- 2.1.1.2 Each State Party shall provide the Technical Secretariat with the contact information of their National Authority to include: name of the National Authority, name of responsible person, voice telephone number, facsimile telephone number, email address, Street address, City, State or Province, Nation, and Postal or Zip Code. Additional contact information may be provided by each State Party if desired.

2.1.2 Roles and Responsibilities of the Director General and the Technical Secretariat

- 2.1.2.1 The Technical Secretariat shall establish and maintain a database with the names of all States Parties and their complete National Authority contact information and shall provide this information to all States Parties to facilitate communication between the TS and States Parties and among States Parties.
- 2.1.2.2 The TS shall manage the cost of establishing and maintaining the liaison with States Parties by tracking the following TS cost centers:
 - 2.1.2.2.1 Staff salary
 - 2.1.2.2.2 Office supplies
 - 2.1.2.2.3 Use of infrastructure
 - 2.1.2.2.4 Postage
 - 2.1.2.2.5 Telecommunication charges

2.1.3 Notification Requirements

- 2.1.3.1 States Parties Contact Information Changes

2.1.3.2 TS-Required Treaty Notifications from the TS to the States Parties.

2.1.4 Coordination Procedures

2.1.4.1 Efforts by the TS

2.1.4.2 Efforts by the SP

APPENDIX U

OSI Workshop-7 Preparations

No workshop is currently planned for the remainder of the year 2000. However, planning is proceeding for OSI Workshop-7 to take place during 2001.

Indicative list of next OSI Workshop topics

Development of the OSI Operational Manual

- Technical overview of the development of the Initial Draft Rolling Text

OSI Methodology:

- Planning and implementation of field experiments
- Case study of Operational Manual procedures of implementation of inspection activities and application of specific techniques

OSI Equipment:

- Testing of radionuclide and geophysical equipment: Programmes and results
- Development of unique OSI equipment (sampling and analysis of noble gases; “blinded” high resolution gamma spectrometers)
- Certification and POE checking of OSI equipment

OSI Operations

- OSI tabletop exercises
- Case studies of operational procedures

Review of contributed texts of Operational Manual relevant to procedures for overflights and continuation period activities of an OSI

Equipment specifications and operational requirements for the conduct of drilling

Administrative and logistic issues, including communications

Recommendations by subject leaders from WS-6:

Focus on OM development as a priority for WS-7 and keep the topics open.

Focus on equipment testing and modification of equipment specifications.

The selection of topics will depend on the progress of development of the OSI Operational Manual and the format of the workshop will be kept flexible